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VIEWS, NEWS AND INTERVIEWS.

Dr. Henrik Blessing, the surgeon and botanist accompanying Dr. Nansen's arctic expedition, has taken with him a box of earth, in which he intends to grow plants under the rays of the electric light when the good ship "Fram" shall have passed beyond the regions of sun-produced vegetation. The forcing bed is to be placed under the glow-lamp in the sky-light of the saloon, and Dr. Blessing hopes to be able occasionally to furnish radishes, cresses, and so forth for the ship's table.

"No doubt," he says, in a letter quoted by the *Pall Mall Gazette*, "it will be refreshing to the eye to have the little green garden to look at during the long Polar night. Oh, wonders of science! Maybe the radishes won't grow to edible size, and maybe we shall prefer to look at them."

Telephone communication has also been rigged up between the look-out man's perch and the engine room, as the noise of crashing ice makes it impossible for the voice alone to be heard. Electricity is playing a large part in this latest attempt to defeat the impossible.—*London Lightning.*

There is a project for uniting the Mexican telegraphic system with continuous land lines through Central America and into South America. It is understood that the project is favored by the governments of Mexico, Costa Rica, Colombia, Venezuela and Ecuador.

The latest electrocution was that of Martin Foy, at Dannemora, N. Y., on October 23. At the first shock the voltage was 1,640. It was on for four seconds at full force, then for 10 seconds gradually reduced to 150; put on at full force again for two seconds, and then gradually reduced again for 46 seconds. At the second shock the current was on at full force for 14 seconds, being gradually reduced.

A curious accident recently happened at Buda-Pesth on the electric tramway line. A carboy of benzine fell on to the roadway from a passing van and was broken, the benzine running over the roadway. A short time afterwards an electric car passed, taking its electricity from an underground conductor. It is supposed that there must have been a spark between the tramcar and the conductor, which fired the benzine, for suddenly the roadway was in flames. Happily they did not last longer than about 10 minutes, but sufficiently long to set fire to the tramcar, which had stopped, and to cause a panic among the passengers.

A writer in the *Génie Civil* has shown that there is a difference in electric potential between the water and gas pipes in all houses, and that if one terminal of a telephone is joined, say, to the water pipe, on lightly touching the gas pipe with the other, a crackling sound will be heard in the telephone, indicating the passage of a current. When the telephone is replaced by the galvanometer, the negative pole is found to be formed by the gas pipe, and the galvanometer deflection to be permanent and constant in amount during several months, but with a slight diurnal variation. The currents are attributed to slow chemical changes. With the currents developed in these pipes the author has succeeded in carrying on a conversation between two houses a hundred metres apart.

A plant for the electro-magnetic separation of blende and spathic iron is in operation at the dressing works of the Ludwigseck mine, in the Burbach Bergrevier, Germany. The blende-spathic iron concentrates from the jigs are heated to redness in a reverberatory furnace, and after calcination are cooled and elevated to a bin in the separating house. The separating machine consists of two manetized chains passing over wooden rolls, which drag the oxide of iron away from the blende. The blende falls back into a bin, while the iron is removed from the chain by a brush, against which it rubs. The machine used at the Ludwigseck mine treats 50 kilograms of ore per 24 hours, and makes a zinc product with 35 to 40 per cent. metal.

Cox's Electric Railway, the first of its kind in the Pennsylvania anthracite region, built for coal transportation, has just been completed. The road extends from Buck Mountain to Eckley, and will be used to haul coal from the mountain strippings to the Eckley breaker for preparation for market.

All the telephone girls in New York have been vaccinated, just the same as if smallpox could be transmitted by wire.

The New England Telegraph and Telephone Company is negotiating with the business men of West Hartford, Conn., and South Royalton, a project for establishing telephone communication from White River Junction to South Royalton by way of Pomfret, there to connect with the line now running into towns by way of Orange County, with a prospective return line to Sharon.

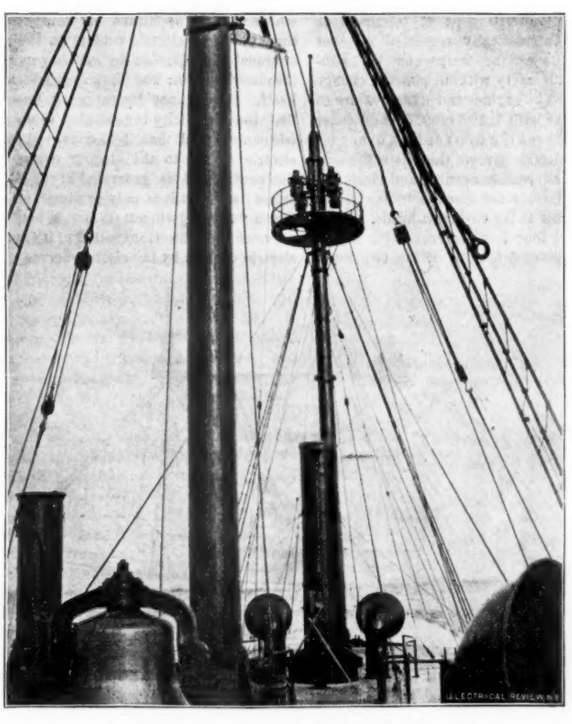

FIG. 1.—DECK VIEW OF "CORNFIELD POINT LIGHT-VESSEL NO. 51," SHOWING ELECTRIC MAST-HEAD LIGHTS.

AN ELECTRIC LIGHT-VESSEL.

THE ONLY ONE IN THE WORLD IS OFF CORNFIELD POINT, CONN., IN LONG ISLAND SOUND—A SUCCESSFUL EXPERIMENT—DESCRIPTION OF THE VESSEL AND ITS APPLIANCES.

BY STEPHEN L. COLES.

Through the courtesy of the United States Light House Establishment, I have been permitted to visit and inspect "Cornfield Point Light Vessel, No. 51," an electric light ship of the highest class and the only one of its kind in the world. A description of this vessel will, I think, be of interest to the readers of the ELECTRICAL REVIEW as an evidence of the application of electricity to one of the highest and most commendable objects—the welfare of those who "go down to the sea in ships." This article is the first complete illustrated description of the vessel and this fact may add to its interest.

The vessel is technically known as "Cornfield Point Light-Vessel, No. 51," and is stationed in Long Island Sound, about five miles off Cornfield Point, Conn., in the Third District of the Light House Establishment. Captain Winfield Scott Schley, U.S.N., who is well-known as the rescuer of Greeley, the Arctic explorer, is the inspector of the Third District, and Lieutenant-Commander C. H. West, U.S.N., is assistant inspector. The vessel marks a dangerous sand shoal, and was built as an experiment which, thus far, has proved eminently successful.

Cornfield Point is not an easy place to reach, and is one of the bleakest and most uninviting spots a man would care to see. Leaving the train at Saybrook Junction, Conn., I secured a wagon and boy to drive the remaining three miles to a farm house near the Point. Walking across rocky fields a half-mile more I reached the shore and, following instructions, tied a big white sheet to a pole and stuck it up in a pile of rocks in a certain place on the bluff rising above the dangerous jagged shore. This was a signal to the ship that somebody wanted to go aboard. As soon as the signal was observed, or it was convenient, a surf boat would be sent off after me, I had been told. The morning was chilly and a light, drizzling rain was falling, making it hard to see any distance on the water. I could scarcely see the ship and the chances seemed favorable for my camping out a week before my signal was seen.

The rising ground and trees hid the farm house from sight, and not a living thing was visible as I paced up and down. The sensation of loneliness was not pleasant, and I felt a great deal like I imagine I would if I were drowning. I was cold and wet, and after three hours of waiting I felt like yelling "A sail! a sail!" when I discerned the

surf boat making straight for me under all sail. Two seamen brought the boat as near as they could to the ugly looking rocks, and one of them waded ashore on a long flat line of stones that slanted gradually out to deep water. He literally took me in his arms, bag, camera and all, and waded back with me to the boat. We then headed for the ship, five miles away. In an hour more I was shinning up the vessel's side, and was glad to get into the warm, cosy cabin, where the bluff sailor welcomes were of the heartiest kind. Although the crew of this lightship is allowed 10 days' "shore liberty" every month, when they can get ashore, the life becomes very monotonous, and they are glad to see anybody on the ship. The monotony of life is more intense on an electric light vessel than on the ships that use oil lights, because the labor of caring for the lamps is not so great, and is much more quickly accomplished. The result is that everything is looked after with painstaking care, and the boiler room and dynamo room are as spick and span as can be.

This vessel was built at West Bay City, Mich., and completed July, 1892. The dimensions are as follows: Length over all, 118 feet, 10 inches; length from inside of rudderpost to inside of stem, 110 feet, 0 inches; beam molded, 26 feet, 6 inches; depth of hold from top of keel to top of beam, 14 feet, 6 inches. The material of the hull is iron throughout, with a tensile strength of 48,000 pounds, and an elongation of 16 per cent. in eight inches as a minimum. The material of the boilers is steel, with a tensile strength of between 58,000 and 67,000 pounds, with an elongation of not less than 22 per cent. in eight inches for shell plates, and a tensile strength of between 50,000 and 58,000 pounds, and an elongation of not less than 26 per cent. in eight inches for flange plates. The vessel is fitted with two continuous deckstringers, is stiffened with breasthooks and five keelsons, also two outside bilge keels. The thickness of the plating is $\frac{8}{16}$, $\frac{7}{16}$, $\frac{6}{16}$ and $\frac{5}{16}$; the bulwarks, $\frac{4}{16}$. The deck beams are of T bulb pattern. The main deck is white pine. There is also a partial iron deck, consisting of stringer, tie-plates, mast and windlass plates of an average thickness of $\frac{7}{16}$ inches.

The vessel is divided by four main bulkheads, extending to the main deck. The accommodations for officers and crew consist of one cabin, four staterooms and beds for 12 men. The vessel is fitted with a steam windlass with three wildcats to operate two 2-inch chains and one 1¼-inch chain. A Baird's No. 3 distilling apparatus is fitted in the deckhouse, with condenser, aerater, filter, circulating pump, etc., complete. The whistle machinery consists of one horizontal non-condensing engine, five-inch diameter and six-inch stroke, attached to the machinery for operating the steam whistle. The diameter of the whistle is 12 inches. There is a wrecking pump with eight-inch suction. The vessel has two masts and four lens lanterns on each mast, hung in brackets 55 feet above the water. Just below the lamps are built round platforms, with a low wire rail serving as day marks. These day marks are painted black. The vessel is painted red, with "Cornfield Point Light-Vessel, No. 51," in white letters on her sides. She has a main stack, a donkey-boiler stack, and the steam receiver for the whistle painted black. The boats, one on each side, are painted exactly as the vessel, with the number and name of the ship. The deckhouse extends from about six feet abaft the mainmast to about 11 feet forward the main smoke stack. The vessel has a raised forecastle 45 feet in length; her stern is elliptic and her bow nearly straight, with hawse hole in the center. The characteristics of the vessel are as follows:

Daytime day-marks and lamps as described. —Nights, four lamps on each masthead operated by electricity.

In a fog.—Blast three seconds; silent interval, 12 seconds. Blast three seconds; silent interval, 12 seconds.

The engine is a compound, inverted surface-condensing. Diameters of cylinders, 14 inches and 24 inches; length of stroke, 18 inches; indicated horse-power, 140, with steam pressure of 100 pounds per gauge.

There are two main boilers, cylindrical, eight feet in diameter, nine feet in length, fitted with Fox corrugated surfaces, 36 inches in diameter, constructed for a maximum steam pressure of 110 pounds per gauge, the grate surface being 35 square feet. There is one donkey boiler, vertical, tubular, seven feet, three inches in height, and 54 inches in diameter. The grate surface is 11.5 square feet. This boiler, designed and built to run the steam windlass and to heat the vessel only, has been connected to the fog signal engine and whistle receiver.

For the electric plant there are two horizontal high-speed engines of the "Ideal" type, with automatic cut-off governor, capable of developing eight horse-power at normal speed with 70 pounds of steam, cutting off at a quarter stroke.

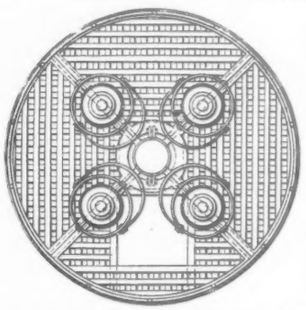

FIG. 2.—PLAN VIEW OF ELECTRIC MAST LIGHTS ON U. S. LIGHT-VESSEL, NO. 51.

The two dynamos are of the Thomson-Houston type, compound wound, of 60 amperes capacity, with an electro-motive force of about 110 volts at terminals of machine, automatically regulated so that three-fourths of the lamps can be extinguished with safety without material change of speed. The engines and dynamos are so located that with the Evans friction cones either engine can run either or both dynamos.

In the electric circuit there is a flashing device for alternately opening and closing at regular intervals the circuits to the incandescent lights at the two mast-heads.

There are four lens lanterns (with totally reflecting prisms) at each of the two mast-heads. Each of the lens lanterns contains one 100-candle-power incandescent lamp, or eight incandescent lamps in all the lanterns.

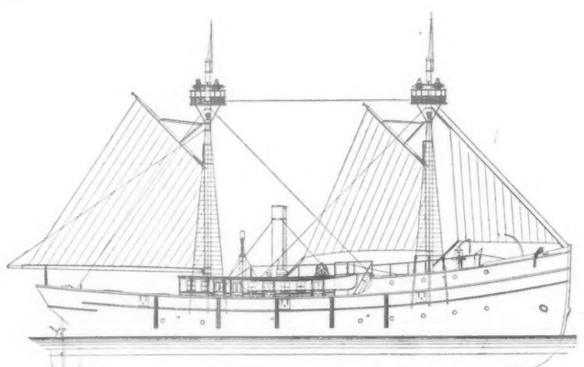

FIG. 3.—ELEVATION OF U. S. LIGHT-VESSEL, NO. 51, SHOWING RIGGING PLAN AND ARRANGEMENT OF ELECTRIC BEACONS.

Besides the incandescent lamps in lens lanterns, the decks of the vessel are lighted by twenty 16-candle-power incandescent lamps.

The vessel is most comfortably fitted up, and is as handsome in every respect as many yachts. She is commanded by Capt. John A. Beebe, with James H. Manwaring as mate, Otto E. Salzman, chief engineer, and William McDermott, assistant engineer. The crew consists of three firemen, a cook and four seamen. Eight men are always on the ship, while the remaining four are on "shore liberty."

I spent two days and a night aboard the vessel, and everything indicated that the electric plant was a complete success. Figures as to cost of operation and maintenance are not available, but it is reasonable to suppose that these are within reasonable limits, or the Light House Establishment would not keep the ship in commission.

Electric Fishes.

Dr. John G. McKendrick tells us some interesting things about electric fishes in the October number of the *Fortnightly Review*. He says that about 50 species of fishes have been found to possess electrical organs, but their electrical properties have been studied in detail only in five or six. The best known are various species of *Torpedo* (belonging to the skate family), found in the Mediterranean and Adriatic Seas; the *Gymnotus*, an eel found in the lagoons in the region of the Orinoco, in South America; the *Malapterurus*, the rïash, or thunderfish, of the Arabs, a native of the Nile, the Niger, the Senegal and other African rivers; and various species of skates (*Raia*) found in our own seas. It is curious that the Nile is rich in electrical fishes, several species of pike-like creatures (*Mormyrus* and *Hyperopisus*) possessing electrical organs, the structure of which has been quite recently investigated by Fritsch. The electrical fishes do not belong to any one class or group, and some are found in fresh water, while others inhabit the ocean.

Two distinct types of electrical organs exist. One is closely related in structure to muscle, as found in the torpedo, gymnotus and skate, while the other presents more of the characters of the structure of a secreting gland, as illustrated by the electric organ of the thunderer fish. Both types are built up of a vast number of minute, indeed microscopical, elements, and each element is supplied with a nerve fiber. These nerve fibers come from large nerves that originate in the nerve centers—brain, or spinal cord—and in these centers we find special large nerve cells with which the nerve fibers of the electric organ are connected, and from which they spring. We may, therefore, consider the whole electric apparatus as consisting of three parts: (1) electric centers in the brain or spinal cord; (2) electric nerves passing to the electric organ; and (3) the electric organ itself. It must not be supposed, however, that the electricity is generated in the electric centers, and that it is conveyed by the electric nerves to the electric organ. On the contrary, it is generated in the electric organ itself, but it is only produced so as to give a "shock" when it is set in action by nervous impulses transmitted to it from the electric centers by the electric nerves. The organs of the torpedo are two large kidney-shaped masses, placed, one on each side, near the head and gills. Each organ is composed of about 800 prismatic columns placed, side by side, vertically between the integuments covering the back and belly, and in a full-sized fish, each prism contains about 600 plates or diaphragms placed transversely, and separated from each other by a jelley-like albuminous fluid. There are thus about 500,000 plates in each organ, or about 1,000,000 in the two. Each plate, which may be called an electric plate, consists of several layers, but the most remarkable layer is one composed of finely granular matter (electric tissue), raised on one side into finger-shaped projections. Further, each electric plate is supplied with a distinct nerve fiber, which, entering its under surface, splits up there into still finer fibrils, which end in the electric tissue. This powerful electrical battery (which is something like an old-fashioned voltaic pile, consisting of disks of metal, zinc and copper, separated by diaphragms of soft cloth or bibulous paper) is supplied with no less than five large nerve trunks, which spring chiefly from a large lobe of the brain near its base. In this lobe we find large, somewhat globular, ganglionic nerve cells, each about $\frac{1}{1000}$th to $\frac{1}{1500}$th of an inch in diameter, and each of which is the starting point of a nerve filament, which breaks up into numerous finer filaments, and these ultimately end in the plates of one of the prisms of the electrical organ.

The electricity evolved from the batteries of these fishes is, it need hardly be said, of the same nature as the electricity produced by any of the appliances now in common use. It produces, to a greater or less extent, the same physical and chemical phenomena. When a living electric fish is touched, it may or may not emit a shock, and it soon becomes evident that it is under the control of the will of the animal. Just as the fish can voluntarily flap its fin, so it can give an electrical discharge. It can also vary the strength of the shock, but it has not been clearly ascertained whether it can discharge a portion of its battery, a single gun, or whether it must fire a broadside at once. The strength of the shock varies in the different fishes. The strongest is that of a full-sized gymnotus, which may in certain circumstances cause a man to stand out rigid like a tetanized frog. It is remarkable that a voluntary discharge is more powerful than one artificially excited, showing that the organ responds best to the excitory processes in the nerve centers. Discharges are also given by stimulating the skin or any sensory neves of the fish. These are of a reflex character, like the movements following tickling the foot of a sleeping person.

A Splendid Catalogue.

The Central Electric Company, of Chicago, has just sent out the fourth edition of its catalogue of general electrical supplies. A special editor, with several assistants, has been at work upon the book for over a year, and the result is what is probably the handsomest and most complete catalogue of the kind that has ever appeared. It is a large-sized book of 525 pages, bound in cloth and gold. The typography and illustrations are better than is usually the case in catalogues, and the arrangement is most convenient. A novel feature of this catalogue is the use of "trade words" prefixed to each article listed in the book wherever it could be done. The idea is to avoid confusion where goods are ordered by mail or telegraph, and to lessen the expense of telegrams. A "trade word" index immediately precedes the general index. The Central Electric Company has also provided its patrons with a telegraphic code which is included in the catalogue. The combination of the "trade words" and telegraphic code is a valuable one, which will save considerable money on telegraph tolls to the patrons of this enterprising company.

The Niagara Falls Contract.

The Westinghouse Electric and Manufacturing Company is to be congratulated on securing the contract to furnish the electrical apparatus for transmitting the power of Niagara Falls to operate manufacturing plants and for other purposes. The initial installation alone amounts to 15,000 horse-power. As the company announce, in this issue of the ELECTRICAL REVIEW, the two largest contracts ever made in this country for incandescent lighting machinery were the World's Fair plant and the plant for the Louisville Gas Company, both of which installations were equipped with Westinghouse alternating current apparatus. In addition, many of the largest street railway companies, such as those in Brooklyn, Jersey City, Philadelphia, Pittsburgh, Chicago, Cincinnati, Indianapolis and St. Louis, are using Westinghouse electric railway apparatus. This is indeed a record to be proud of.

Steam Power and Electricity in Switzerland.

J. C. Monaghan, United States Consul at Chemnitz, under date of August 14, 1893, has transmitted to the Department of State the following report on the use of electricity and steam power in Switzerland, which is decidedly unfavorable to the former. The report seems to carry an intimation that its author was an advocate of steam power in advance:

Just now Saxony, of which Chemnitz is doubtless the most important manufacturing center, is interested in the comparisons being made in Switzerland between steam power plants and electricity gained by utilizing water.

It used to be urged that Switzerland's water supply, if properly utilized for obtaining electricity, would reduce very considerably her cost of production. Not only has she many streams, but they fall from such heights that even rivers of small volume have great power. "Millions of horse-power are going to waste in these hills," was a common expression. "Switzerland had only to make sluices, put in wheels, lay wires, and get for a 'song' what other less-favored nations had to buy with enormous consumption of costly coal," was what even scientists said only a few years ago. The sluices were laid, dams made, wheels hung and wires put down. What is the result? Every effort that science could suggest, ingenuity devise, or mechanics arrange, was made in different cantons of the little republic to gather electricity by, and transmit it from, her rivers and streams. The latest reports show that if Switzerland, or any country with streams and climate like hers, is to win her way into the world's markets, and take a place in the front ranks, it must be by some better method than the use of electricity gained and transmitted from rivers and waterfalls.

The following table, just published in Chemnitz, shows what 50, 300 and 500 horse-power costs in England, Germany, Bohemia and Switzerland per annum:

Country.	50 horse-power.	300 horse-power.	500 horse-power.
England	$24.24	$12.58	$9.88
Germany	29.21	15.52	13.51
Bohemia	27.50	14.74	12.97
Switzerland	46.82	29.61	25.54

Compared with the above, the cost of the same amounts of horse-power of electricity transmitted 3.1068 miles (5 kilometres) in an air-line in Switzerland, according to results published in connection with the foregoing table, is as follows: Fifty horse-power, $30.88; 300 horse-power, $16.98; 500 horse-power, $12.54. But to this must be added the transmission cost, which will make the total as follows: Fifty horse-power, $57.68; 300 horse-power, $31.27; 500 horse-power, $25.48.

How, at these rates, is it possible to turn from steam to electricity? How is it possible for a people using so uncertain and expensive a power to compete with England, Bohemia, Belgium or Germany? It is only by building a big plant, 500 horse-power at the very least, that electricity begins to show any profit that would commend it as a substitute for steam. It is only then that its prices sink to those of the same amount of power yielded by its rival. The 50 and 300 horse-power gained by steam, even in Switzerland, come cheaper than the same amounts of electric power produced and transmitted from the rivers. These facts may be disappointing, but there they are—the results of experiments.

Switzerland, with its freshets, its uncertain supply of water (for, though there may always be enough, there may at times be too much), its icy Winters, its electrical disturbances during mountain storms, and its dangers from high strained change currents, causing much inconvenience and labor in laying, caring for and repairing the wires that carry the currents over long distances, is, after all, hardly the best place in the world for this experiment. What is true of Switzerland is true of other countries in the degree that these difficulties appear.

Add, then, to all these the necessity of keeping up a large reserve steam plant to carry on business when, from any of the causes cited, electricity fails. It is not claimed, however, that at all times and under all circumstances it will not pay to obtain power from streams and transmit it in the form of electricity. Where work is carried on day and night, in cases where the power is used also to supply light (which it does at very small cost), it can be made to take the place of coal at cheaper prices. Again, some streams are much better suited for electrical power purposes than others and are often much more easily utilized. Then, too, there are valleys and places wherein the transmitting plant need not be very long—less, perhaps, than three miles, or not even half a mile. In such cases the transmitting plant, which (see figures in the experiments made) increased the price almost double in the case of 50 and 300 horse-power, and more than double in the case of 500, need be neither very large nor very costly. In the exercise of foresight, common sense, scientific knowledge and skill, there is no reason why, with the many new inventions in the field, later experiments may not result in still further reducing the price per horse-power. With our many rivers of large volume, there is no reason why the results should not be more favorable than those made among the Alps.

Just now the experiments being made in Switzerland are of vital interest to us whose mental efforts, if not practical experiments, are bending towards a utilization of the Niagara, Mississippi, Merrimac, and other streams for the purpose of supplying electrical power to the mills and shops of the United States.

Engineering Association of the South.

At the regular meeting of the Association, in Nashville, Tenn., October 12, Prof. Wm. W. Carson, of Knoxville, Tenn., presented

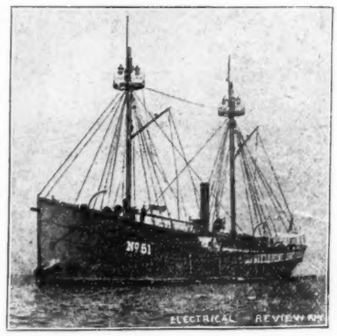

FIG. 4.—"CORNFIELD POINT LIGHT-VESSEL, No. 51."

a paper entitled, "A Plea for a More Rational Presentation of the Calculus." The beginner in the calculus finds the continuity of mathematical science broken, and, instead of meeting the characteristic clearness of proof, he is surrounded by perplexity and darkness. The author investigates the causes of this state of affairs and proposes a remedy. The demonstrations of the calculus of to-day rest on limits, or on infinitesimals, or on both. The former proves the formulas without giving any foundation or any explanation of the nature of the calculus; the latter explains, but does not prove; yet, as it leads directly to true results, it is accepted. Proofs by limits, when sifted down, rest on slippery definitions and ambiguous language; infinitesimals are invested with the property of changing their magnitude from the considerable to the inconsiderable, as occasion may demand. The author repudiates the doctrine of infinite quantities, both infinitely great and infinitely small; such a classification is artificial and useless. The equations of the infinitesimal calculus are false to him who understands the *dx's* and *dy's* to stand for infinitesimal increments, though true to him who understands them to stand for something else; and it is by performing the operations of the latter's conception that true results are obtained. Instead, the author would introduce *hypothetical* quantities. A real occurrence takes place by a continuous change of conditions, and in a real magnitude the conditions are different for the different parts; the hypothetical quantity is what we suppose would exist under a reduced number of conditions actually obtaining in the real. The calculus is defined as "that branch of mathematics which connects real and hypothetical quantities." The problem of the differential calculus is—given the real quantity to find the hypothetical; that of the integral calculus is—given the hypothetical to find the real. The investigator desires to find a certain real magnitude, which, by reason of the complexity of the conditions, is beyond the reach of his other mathematics; he turns to the hypothetical and considers a magnitude similar in nature to the real, and that would exist if the conditions were less complex; if this simple magnitude is within the reach of his mathematics, he passes, by the rules of integration, to the real, otherwise the process is repeated until the conditions are sufficiently simple; then, by a sufficient number of integrations, the real is reached. With this conception of hypothetical quantities are logically derived those equations got by the limit calculus, and what its "derivatives" are is shown; multiplying these equations through by *dx* gives the equations used in the infinitesimal calculus.

American Institute of Electrical Engineers.

At the regular monthly meeting of the council, held October 18, six associate members were elected. The following resolutions were subsequently passed:

"Whereas, Requests and suggestions have been received from members in various parts of the country, looking to the holding of local meetings for the reading and discussion of papers, and

"Whereas, It is the sense of this meeting that any measures proposed with the view of increasing the usefulness of the Institute to its distant members should have earnest consideration and careful action, it is hereby

"*Resolved*, That the president be requested to appoint from the council a committee to consider the subject of local meetings; such committee to be supplied with copies of all correspondence and papers on the subject in the files of the secretary, and that the council report as early as possible to a monthly meeting of the Institute: First, upon the expediency of local meetings; and, second, if they deem such meetings expedient, to recommend a suitable plan for the organization of local meetings and for their proper relation to the general body."

Electric Car Runs Through an Open Drawbridge.

Owing to a heavy fog at about 6.30 o'clock in the morning of November 1, an electric car loaded with passengers ran through the open draw of the Madison street bridge across the Williamette River, at Portland, Ore., and sank out of sight.

Thirteen persons are believed to have been drowned. The car was one of the Oregon City division of the East Side Railroad Company. The motorman stayed with the car as long as possible, having a very narrow escape for his own life.

Society of Naval Architects.

The first general meeting of the Society of Naval Architects and Marine Engineers will take place in New York city, at 10 A. M., Thursday, November 16, 1893. Through the courtesy of the president and managers of the American Society of Mechanical Engineers, the meetings will be held in the rooms of that society, No. 12 West Thirty-

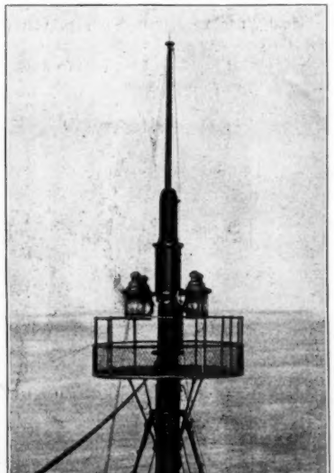

FIG. 5.—VIEW OF MAINMAST LIGHTS FROM FOREMAST-HEAD.

first street, the sessions extending through Thursday and Friday, November 16 and 17.

The Worcester and Millbury, Mass., Street Railway Company is about to equip one of its cars with the new Lawrence brake, patented by William Lawrence, of Millbury, Mass. The brake is applied to the rails instead of to the wheels. The brake shoe, which comes in contact with the surface of the rails, is about 18 inches long and two inches wide. The face of the shoe is made with teeth much the same as a gear rack. The brake is worked with an ordinary ratchet handle, and the points of contact between the rails and brake shoes are midway between the front and rear wheels.

Electricity by Water-Power.

THE FUTURE OF THE ROCKY MOUNTAIN STATES—BY OSCAR BRADFORD.

No invention of modern times, unless it was the steam engine, has exerted such a far-reaching influence over the distribution of population as that of Sir Henry Bessemer in his process for making cheap steel. The steel rail has enabled railroad companies to increase the weight and carrying capacity of their rolling stock and thereby so reduce the cost of freight that the farmer of the Mississippi valley could lay down his products on the Liverpool market at prices lower than any competitor. This demonstration was at the bottom of an emigration that astonished the world. Under its influence population was pushed westward nearly to the base of the Rocky Mountains and to the extreme limit of the rain belt. The Bessemer converter really gave to Chicago its million and a half of people and insured growth and prosperity to St. Paul and Omaha, St. Louis and Kansas City. With a fertile soil were combined the advantages of cheap coal for heat, light and power. Water and rail transportation seemed to indicate that in the Mississippi valley and on the plains of Kansas and Nebraska there existed all the elements necessary to create an empire unequaled for numbers and wealth in the history of the universe.

But shrewd observers see in the immediate future the commencement of a movement destined to reach proportions beyond precedent. They see conditions which insure the birth of a new and greater empire as the result of another invention—the dynamo. No one need be told of the advances made by electricity as an aid to human effort in the past 10 years, even under the discouragements of undeveloped appliances and expensive fuel. What will it be with perfected mechanism and no requirements for coal? What cannot be said in favor of a country where heat, light and power are practically free, where habitations are maintained at a comfortable temperature for next to nothing, where night can be turned into day by the luminous carbon, where the cooking is done by the turning of a switch, and machinery harnessed to unlimited power, all through the agency of a waterfall inexpensively trained to man's use by a turbine wheel? Add to these advantages a soil so rich that it would manure the blackest loam in Illinois, a climate so healthful that disease is almost banished and rainfall a manifestation to be controlled independently by the will of each cultivator; locate mountains of gold, silver, copper and lead ores, of coal and iron, every variety of building stone and sand and clay without limit; find thousands of square miles of valuable timber, broken and threaded by beautiful lakes and running streams, and there you have the Rocky Mountain region, extending from the northern border to Arizona.

It is evident that under such conditions a comfortable existence can be maintained with the least effort, hence the certainty that with a return of financial ease a mighty movement of population will be headed toward the setting sun. That a hunger for land exists is evidenced by the contentious strife of the invaders of Oklahoma and the Cherokee strip. What may be expected when the people realize that millions of acres may be had for the asking in a country which irrigation will make as fruitful as the Nile valley and where on all sides never-failing waterfalls solicit work? What boundless opportunities will capital find for investment in the canals and electrical developments, in the railroads to be called into being by the enormous traffic and in the rapidly enhancing town and country property?

The possibilities of the subject are exhaustless, and they will soon be written in the throng of emigrants and capitalists westward on settlement and profit bent, in the swelling tide of population which will enliven the mountain valleys and make of Helena and Spokane, Salt Lake and Denver cities in which the wealth and power of the republic will find no grander expression.

The Station of the Edison Light and Power Company, of San Francisco.

Of all the central stations in the United States for the supply of electricity none can lay claim to greater age than, and but one or two to as perfect an installation as, that of the Edison Light and Power Company, of San Francisco, California, which, under its present management, has attained a degree of prosperity which many of the stations east of the Rockies might envy.

In 1879, when the arc light was a new invention at which people marveled, the California Electric Light Company was incorporated to operate some Wallace-Farmer electric machinery, but unable to obtain satisfactory results with it, made an arrangement with the Brush Electric Company to operate their apparatus, and began the lighting of San Francisco from a central station, which, it is said, was the first central station ever built in the United States. This was burnt down in 1880, but was immediately rebuilt. The customers increased rapidly; they had tried the new light and found that it was good, and the new station was enlarged in 1882, and again extended in 1885. In less than three years afterwards, even this larger station became too small for the business, and in 1888 a new station was erected, which was at that time the largest in existence. This is still occupied and is known as station "B." In July, 1891, the Edison Light and Power Company was incorporated, with Geo. H. Roe as president—the same man who, full of hope as to the future of electric lighting, had founded the California company. This company, with an authorized capital of $3,000,000, was formed to operate the Edison incandescent system, and to take over all the rights and franchises of the California Electric Light Company. By this consolidation both the arc and incandescent lighting systems of the city were brought under one head, and at the present time the company controls not only the Edison and Brush rights, but also the Thomson-Houston, Fort Wayne, Excelsior and Schuyler rights. In other words, it has a virtual monopoly of both electric lighting and power work in San Francisco, and it holds the only franchises for overhead wires and poles and underground conduits for electric lighting and power ever granted in the city. What the value of such rights and franchises may be, can readily be appreciated by men experienced in the electrical business.

The new company at once began the erection of still another station, business having so largely increased as to render the older premises too cramped for satisfactory operation, and to place therein the machinery necessary to operate the Edison incandescent system. It was determined from the start to make this station absolutely modern in all its appointments, and no old machinery has found a place there. This station, known as station "C," was completed in 1892, and in its present state may be called a perfect model of its kind. It has a present capacity of 44,000 incandescent lights, and provision has been made for an ultimate capacity of 87,000 lights. It is located on Jessie street, adjoining station "A," the two having a total frontage of 300 feet. It is a substantial structure of brick and iron, practically fireproof, and covers an area of about 14,000 square feet.

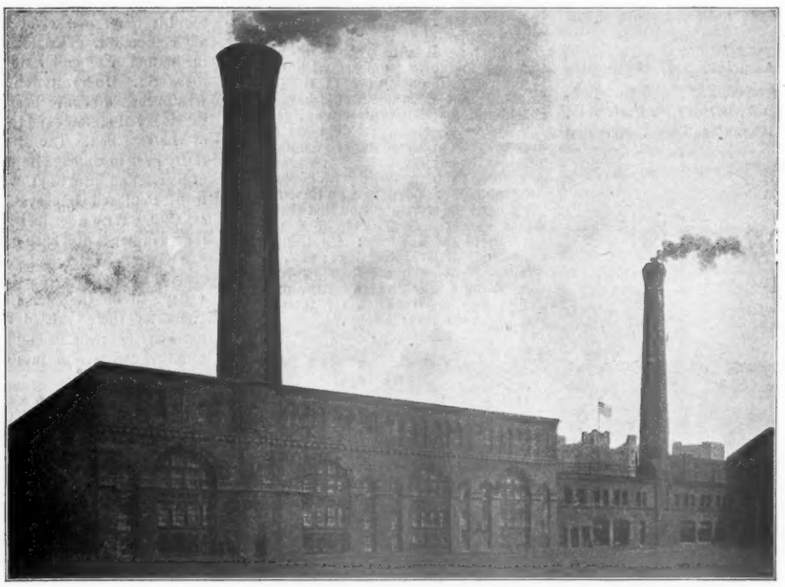

FIG. 1.—STATION OF THE EDISON LIGHT AND POWER COMPANY, OF SAN FRANCISCO.

The boiler room is laid out for thirty 250 horse-power boilers, to work under a pressure of 165 pounds. Above the boilers are located the large iron coal storage bins. From these the coal is fed through chutes to hoppers, which feed the mechanical stokers. These, in turn, force the coal up into the furnace from beneath, and thus prevent the ingress of cold air to the boilers, while providing for the complete combustion of the gases, the coal being heated to a high degree before being actually burned in the furnace.

The engine room adjoining is about 80 feet square, with a ceiling 37 feet high. Around the walls runs a gallery at a height of about 14 feet from the floor. The foundations for the engines are of concrete, 14 feet in depth, and the six cover an area of about 3,600 square feet. They have no connection with the building proper, but are entirely independent, and thus no jarring is noticeable in the station. The generating plant consists at present of four general electric combination sets, *i. e.*, two 100 kilowatt multipolar dynamos directly connected to an Edison triple expansion engine of marine type, and six 200 kilowatt multipolar dynamos, each pair of which is similarly connected. Four more 200 kilowatt machines will be put in later. The belted dynamo has no place in this station.

The switch board located in the gallery is one of the largest and finest ever built. It is of solid marble, polished, 57 feet long and nine feet high. This has already been described by us in our issue of January 7, 1893, before it left the factory for the West. On the floor above the engine room are the offices of the chief engineer and chief electrician, the laboratory, meter room, draughting room and repair shop. The laboratory is fitted up with the most modern devices for extremely delicate electrical measurements, and is the standardizing center for all electrical instruments on the Pacific Coast. The repair shop is equipped with tools to take care of any emergency, and all repairs and alterations are made therein. The great distance from the electrical factories and consequent high freight rates, as well as loss of time in transit, render these precautionary equipments necessary.

A novel feature of the company's plant is a tunnel three feet by six feet, which has been constructed below low tide level, from the station to San Francisco bay, for providing a supply of water for condensing purposes. The outlay for this finds its justification in the high price at which coal is sold on the Pacific Coast.

Summing up, the total boiler capacity of the three stations is 8,500 horse-power, the total engine capacity 7,700 horse-power. It has 478 miles of wire in its overhead circuits strung on 4,086 poles, and there are already laid 12½ miles of Edison underground conduit. The Palace Hotel, of San Francisco, the largest hotel in the world, has recently turned out its isolated plant, and its 7,000 lights will now be supplied with current from station "C." This hotel is the largest individual consumer of electric current supplied from any central station.

The Edison Light and Power Company numbers among its stockholders many Eastern investors. It pays monthly dividends at the rate of eight per cent. per annum, either at San Francisco or at the office of the New York Guarantee and Indemnity Company, New York. Its officers are George H. Roe, president; Gustav Sutro, vice-president, and J. E. Green, secretary.

Although situated at the western extremity of this continent, this San Francisco plant may be considered as one of the best managed and best paying in this country.

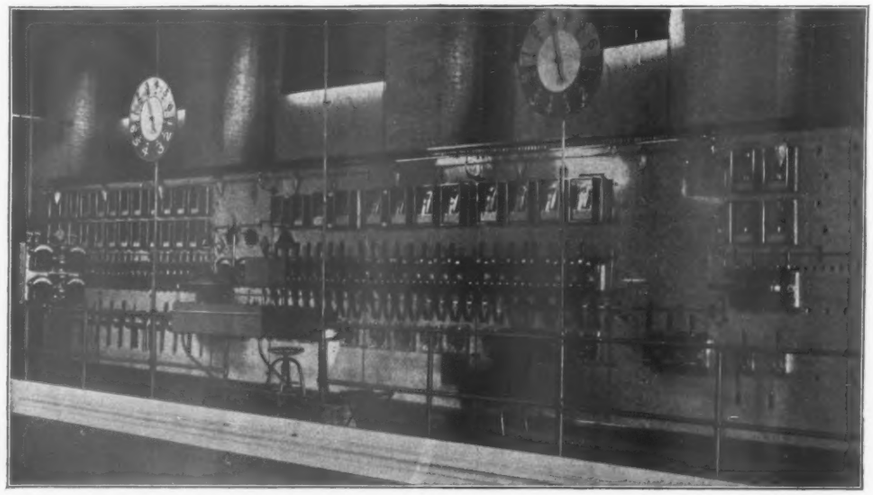

FIG. 2.—SWITCH BOARD IN THE STATION OF THE EDISON LIGHT AND POWER COMPANY, OF SAN FRANCISCO.

ELECTRIC LIGHT FLASHES.

Reslyn, Ore., is now lighted by electricity.

There is talk of electric lights at Colfax, Ind.

The town of Pomona, Cal., will be lighted with electricity hereafter.

The electric light company, of Milford, Mass., has discontinued its 330 volt three-wire system, and is now using the 1,000-volt two-wire system altogether.

The Northampton, Mass., Electric Light Company have voted to begin the erection of a new plant, to cost $50,000 or more, at once. Its capacity will be 200 arc and 4,000 incandescent lights.

For the third time a special election is to be held in Lansing, Mich., on November 9, for the purpose of voting on the question of issuing $85,000 of electric light and bridge bonds. The last election was illegal.

The electric light works in Sterling, Kan., took fire on Oct. 27, after they had been closed for the night, and before the firemen could get the flames under control the building and plant were completely destroyed. There was no insurance on either, and the loss to the proprietors will be several thousand dollars.

The People's Light, Heat, Power and Water Company, of Camden, N. J., which was incorporated on Oct. 25, with a capital of $100,000, intends to become a bidder for the lighting of Camden's streets by electric lights. The new company's incorporators are Henry B. Wilson, president of the Camden National Bank; Edward Dudley, a well-known lawyer and capitalist, and Seldon Twitchell, of Philadelphia, who is identified with the Stockton Water Company. The new company will become a rival of the Camden Lighting and Heating Company, and a lively fight is anticipated when the Camden Company's present contract with the city expires, nine months hence.

The Taxation of Patents.

(From the New York Sun.)

In the case of the Edison Electric Illuminating Company, just decided by the Court of Appeals, that corporation had been taxed upon $1,000,000 as being the true value of its property which was liable to taxation under the laws of this State.

This assessment was sustained in the lower courts, but has been set aside by the Court of Appeals on the ground that there was no evidence before the Commissioners of Taxes to sustain it. More than two millions of the capital stock of the Edison Company was issued to Mr. Edison for patent rights; and it was argued by the counsel for the company that this portion of the capital was not taxable, inasmuch as a State possessed no authority to impose a tax upon money represented by patents issued by the United States.

The Court of Appeals disposed of the case in favor of the Edison Company, without passing upon this particular point, saying:

"This question as to the validity of the taxation by or under State authority of patents issued by the United States for new and useful inventions is a most important one. We do not think it necessary to decide it in this case, for the reason that we regard the assessment as clearly erroneous even upon the assumption that the patents are taxable."

This language, which is used by Judge Rufus W. Peckham delivering the unanimous opinion of the court, is the plainest sort of intimation that there is serious doubt whether a State can tax corporate property so far as it consists of patents. In view of the suggestion, coming from such a source, it can hardly be long before the question will be presented in such a way as to demand a decision. We should hardly have supposed, however, that the question was debatable. The Supreme Court of the United States has held that patented articles are subject to the police power of the several States, and we are unable to see why they are not equally subject to the taxing power, so long as no distinction is made against patents as such. If it may be said that the power of taxation as applied to patents could be used by the State in such a way as to deprive the patents of any value, the same argument is applicable to the exercise of the police power. In a case which arose in Kentucky, the State inspector condemned a patented burning oil as being unsafe for illuminating purposes, and the vender was fined for offering it for sale. The Supreme Court at Washington decided that the statute of Kentucky under which the fine was imposed was a police regulation relating exclusively to the internal trade of the State, and did not intrench upon any authority in respect to patents which was vested in the national government. Nevertheless, it will be perceived that the effect of enforcing the State statute was to render the patent for this particular oil absolutely worthless within the limits of the commonwealth of Kentucky.

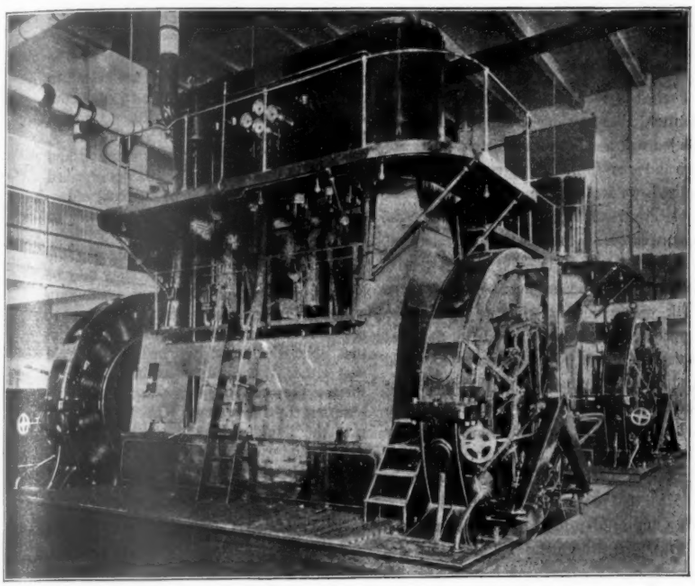

FIG. 3.—ONE OF THE GENERAL ELECTRIC COMPANY'S MULTIPOLAR GENERATORS IN THE STATION OF THE EDISON LIGHT AND POWER COMPANY, OF SAN FRANCISCO.

Ring Off, Please!

There is a telephone in their residence, and as it is used principally by Mrs. Binks and her friends it is perhaps natural that it should be identified solely with Mrs. Binks, and that Mr. Binks — well, Mr. Binks answered when the bell rang a few nights ago, and this is the conversation that took place:

"Hullo!"

"Well?"

"Is this Mrs. Binks?"

"No."

"I mean is this Mrs. Binks's telephone?"

"No; it's the company's."

"Well, is this Mrs. Binks's house?"

"I don't know. I'm beginning to think that perhaps it is."

"What?"

"Yes. I guess it is. Everyone seems to think it is, anyway."

"Is Mrs. Binks's daughter there?"

"No."

"Well, who is this?"

"Oh, this is only Mrs. Binks's husband, the father of Mrs. Binks's daughter, the man who lives in Mrs. Binks's house and occasionally drives Mrs. Binks's horses. She got him with the house, you know."

"Oh, she did!"

"Yes, she did."

"Tough on Mrs. Binks, isn't it?"

That telephone will probably be taken out of the house.—*Exchange.*

Mr. Charles Wirt.

Mr. Charles Wirt, for the past three years electrical engineer for the Ansonia Electric Company, has opened an office as consulting engineer at 56 Fifth avenue, Chicago, where he will make a specialty of incandescent lighting work. Mr. Wirt is best known for his long connection with Mr. Edison and the various Edison interests with which he was connected for a period of over eight years. Few men have been in the business so long or had an equal opportunity for obtaining a many-sided knowledge and practice. The numerous articles in common use bearing the name of "Wirt" are a witness to his judgment in matters electrical, and appreciation of commercial demands. Investors, inventors and constructors, all have frequent need of just this class of talent.

The Telephone Girl Wins.

The South Carolina Presbyterian Synod in session at Clinton, S. C., on November 3, by a vote of 63 to 40, declared in favor of Miss Sadie Means, the telephone girl who was refused communion in the Presbyterian church in Columbia because she worked at the telephone exchange for three hours every Sunday. The Charleston Presbytery had decided, with the session of Miss Means's church, against her, and adjudged that she had committed a grevious sin in attending to her business at the telephone on Sunday. The case came before the synod on appeal from Charleston Presbytery.

Rail Bond Spring Bushing.

The best method of connecting the return circuit on electric roads is attracting a great deal of attention at this time. In the early days of electric roads this matter was not given the attention it deserved. While it has been recognized that a perfect return circuit was needed, yet the means of making provision for such return have been very imperfect and unsatisfactory. The old style rail bonds did not make a perfect joint, the one piece rail bond was found expensive, and, there being no head to drive, it was found almost impossible to use it; the channel pin was hard to drive, and the result was unsatisfactory, as it was bound to come out in a short time.

The Railway Equipment Company, Chicago, have studied up this important matter, and, realizing the necessity of providing an economical and practical connection, one which would provide an absolutely perfect connection, doing away with the possibility of corrosion, oxidation or electrolysis—in fact, making such a solid joint that no air or moisture could possibly enter to destroy the connection—have lately brought out a new rail bond spring bushing, which bids air to become standard in the trade. The bushing is a steel tube, and measures one-thirty-secondth inch larger than the hole in the rail; an opening in the bushing measures just one-thirty-secondth. When the bushing is put on the wire and driven in the opening closes tightly, and results in making practically one piece of the rail, bushing and wire. As a needed addition to the equipment of electric roads, this device is worthy of investigation.

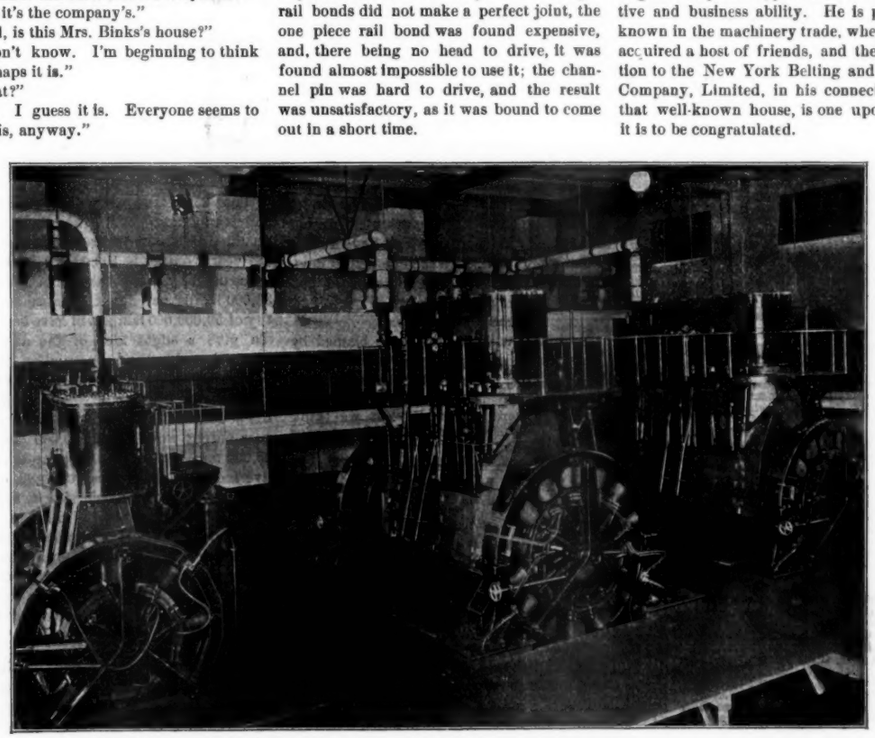

FIG. 4.—VIEW IN THE DYNAMO ROOM OF THE EDISON LIGHT AND POWER COMPANY, OF SAN FRANCISCO.

PERSONAL.

Mr. A. D. Newton, of the Eddy Electric Manufacturing Company, Windsor, Conn., started for a short visit to the West last week.

Mr. Leonard Forbes Beckwith, chief engineer of the Empire City Subway and Telegraph Company, of New York, is reported to be suffering with insanity at his home at Lenox, Mass.

Mr. A. A. Knudson, one of the patentees of the new "Ideal" wire, who has been spending the past Summer at the Phillips Insulated Wire Company's factory, at Pawtucket, R. I., in the interests of that wire, has returned to New York, and is now identified with that company in placing the same on the market at their office in Cortland street.

Capt. Frederick Holmes, of the Twenty-third regiment of this State, was married on Monday to Miss Colgate, of Brooklyn, and will make his home in Passaic, N. J., where he is employed in business for the Okonite Company. The REVIEW extends its hearty congratulations, in which the captain's many friends in the militia, as well as in electrical circles, will all join.

Mr. F. A. Winchell, for a number of years prominently connected with the Crane Company, of Chicago, as auditor, has associated himself with the New York Belting and Packing Company, Limited, 13 Park Row, New York city, as manager of sales department. Mr. Winchell is a gentlemen of genial disposition, possessed of fine executive and business ability. He is popularly known in the machinery trade, where he has acquired a host of friends, and the acquisition to the New York Belting and Packing Company, Limited, in his connection with that well-known house, is one upon which it is to be congratulated.

The directors of the Northampton, Mass., Electric Light Co., held a meeting on October 30, at which it was decided to commence work on the erection of a new plant at once. The work contemplated will necessitate an outlay of about $50,000, and when completed the plant will be first-class in every respect. The capacity of the new station will be 200 arc and 4,000 incandescent lights. Power will be furnished by two 750-horse-power compound condensing engines.

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We publish this week an interesting illustrated description of an electric light ship. This vessel is the only one of its kind in existence, and from all accounts has proved to be a successful experiment.

To George Westinghouse, Jr.: The ELECTRICAL REVIEW extends congratulations over that Niagara Falls order. You have a right to be proud of it. To the competing companies we would say, may you succeed better next time.

Electricity will, no doubt, be blamed by the vigilant daily press for the Portland, Ore., accident, when an electric car plunged through an open drawbridge and several passengers were drowned. Yet we think the open drawbridge and the careless tender were largely to blame.

Mr. Fred. De Land, the well-known electrical newspaper man, will hereafter have charge of the Western interests of the ELECTRICAL REVIEW, with offices at 565 "The Rookery," Chicago. Mr. M. J. Bulkley, who has represented the ELECTRICAL REVIEW in Chicago for two years past, leaves us to enter another line of business, and takes with him our best wishes for his future success.

Mr. Whistler, that peculiar London artist, who creates symphonies in blue and silver, and is the author of "The Gentle Art of Making Enemies," has formulated a theory. It is to the effect that the office of nature is to imitate art. A writer in the New York *Evening Sun* states that scientists have discovered the same disposition in nature to follow the devices of men. This writer cites as an instance that when the Atlantic cable was first laid no marine animal would come near it, owing to the smell of the rubber; now an entirely new animalculæ has been produced with a passion for chewing india rubber. We wonder whether the experience of the cable companies tallies with Mr. Whistler and the writer quoted? It may be said parenthetically that Mr. Whistler's theory is, as usual, one opposed to the majority.

THE REVIVAL OF BUSINESS.

The ELECTRICAL REVIEW is pleased to note the revival of business in the industrial and technical field it represents.

For some five months past there has been a depression in financial and industrial circles, and the electrical field, along with others, has been a sufferer.

To-day an improvement is to be felt in all directions, and, although it is gradual, we feel that it is sure and that the future promises well.

There has been no attempt to obscure the situation at any time in the utterances of this journal, and now that better times are here and a continued improvement is being realized, we feel like congratulating all the stable electrical houses who have successfully weathered the storm and remained firm, while failures in other fields were a matter of daily occurrence. We think we speak within bounds when we say that the electrical interests have stood the financial depression much better than was expected of so young an industry, and those concerns who have remained solid during the financial trouble may be considered as "tried by fire," and need have no fear for the future.

A few went down, and to them we extend the wish that they may be able to try again. It is a matter of pride with the ELECTRICAL REVIEW that, with one single exception, not a patron of the advertising columns of this journal failed, which is evidence that our patrons are in good company and have no cause to be ashamed of their neighbors.

The future is promising. To one and all in the electrical field the ELECTRICAL REVIEW extends greetings over the return of this great country to its proper senses, and well wishes for a renewed and continued prosperity.

The manufacture of the incandescent lamp has been one of steady growth. In one factory alone, in 1881, the output was in the neighborhood of 100,000 lamps; after the lapse of 12 years the figures have so expanded that the yearly output is nearly 10,000,000 of lamps. Let us make a few calculations and try to comprehend what this enormous quantity of lamps means. It means that if the yearly output is 10,000,000 in the short space of five years, at the rate of a little over 33,000 lamps per day, the enormous quantity of 50,000,000 lamps will have been made. To give a slight idea of the amount of material used in their construction, we must consider that the lamp entire weighs about 1.6 ounces. This would make ten lamps to the pound, and the entire weight of the five year output would be 5,000,000 pounds, or 25,000 tons. Supposing the lamp to measure five inches in length, and two and one-half inches in diameter, placed side by side, they would cover a line 19,728 miles in length, and end to end, 39,457 miles. These are figures remarkable for the way in which they give a slight idea of the growth and importance of the incandescent lamp industry. What are we to expect when patents begin to expire?

An important legal decision, involving the use of the telephone, has been made. A man in Boston had a claim on some notes against a firm in New York, and wished to attach some money the latter had on deposit here. The facts were telephoned from Boston to a firm of New York lawyers, who were requested to secure an attachment. The facts, as transmitted by telephone, were embodied in an affidavit, and an attachment was secured against the Boston man's money in the New York bank. A motion was made in the Supreme Court by the Boston man's lawyers to vacate the attachment upon the ground that it did not appear that the Boston man had any previous acquaintance with the lawyers here, or that they had any means of knowing that it was the Boston man with whom they had spoken. Judge Barrett vacated the attachment.

LETTERS FROM A LABORATORY.—LXX.

BY JULIAN A. MOSES.

The manufacture and production of alloys of the metals have done much towards perfecting and improving kindred and dependent processes and inventions. Excellent compositions of all kinds have been put upon the market, and no pains in working and experimenting have been spared to make the best possible compounds.

In the production of an alloy by the methods now in use, the metals are heated to their melting points and while in such condition are stirred together with a wooden, metal or carbon rod. The object of this is, of course, to prevent undue oxidation and cause a reduction of the oxides formed by the use of the wooden or charcoal rod.

This is one of the many difficulties in making alloys.

The action of metals undergoing the process of being made into an alloy may be likened to the action of a sponge soaking up a liquid. Imagine, however, that the sponge or absorbent material could be heated so hot that when the liquid touched it, the liquid was either vaporized or oxidized. In the former case nothing but a vapor would be absorbed by the sponge, and in the latter case the liquid would be so changed in its nature, that even if the sponge did absorb it, its character and properties would be entirely different from what they were originally intended to be. So it is with the molten metals; one metal simply commingles its molecules with those of the other, or others, as evinced by the fact that no new compound is formed, the original elements allowing of separation by chemical means.

If, therefore, we have a condition similar to that of the heated sponge, one metal having a much higher melting and oxidizing point than the other, a difficult mixing results, especially if the specific gravity of the elements are widely different. A violent mechanical agitation must ensue in order to get a satisfactory admixture.

A more quiet, less dangerous, and, in short, a rather novel way, is obtained by an electrical process. A large drum is provided which turns in a trough, and which has on its surface a conducting layer of graphite. This surface has an electrical connection with a suitable plating generator and serves as the cathode. On either side of the drum, which must be slowly revolved, hang several anodes which are of the metals required in the alloy. These anodes necessarily dip into the solution which covers them and surrounds the drum. Compound salts of the metals used must, of course, be dissolved in the required solvent to form the solution. The ingenious part of the apparatus consists in the fact that any required proportion of the two elements may be readily combined.

The rates of deposition of the two elements are first determined considering the size of the cathode, and then by a simple commutator device, more or less current can be sent through each anode separately.

It will thus be seen that if the depositions are alternating, first one metal and then the other, innumerable thin layers surround the cylinder and we have the infinitely small molecules very close together. A thorough incorporation of one metal with the other is obtained and when a sufficient quantity of the alloy is obtained it may be removed from the drum. The cylindrical mass may be melted, molded and treated as an alloy made by any other method.

It will be found advantageous to make by this method those alloys of metals having specific gravities widely different. In the case of aluminium solutions of those metals must be used which are not precipitated by the aluminium salts, and in all cases due regard must be taken of the chemical action of the salts upon each other.

Miss Sadie Means, the South Carolina telephone operator who worked at the exchange three hours every Sunday, has been acquitted of "grievous sin" by the Presbyterian Synod This is proper. The charge never should have been made against the lady.

CORRESPONDENCE.

OUR WESTERN LETTER.

Receiver's Sale.—The National Electric Manufacturing Company's plant and all thereto pertaining was, on Wednesday, sold to one of the stockholders for the sum of $75,000.

The Electric Launch and Navigation Company.—President Wyman is well satisfied with the results of the season's business. The plant is reported to have cost $165,000, and as more than a million passengers were carried, a reasonable profit on the investment is assured.

A Gasoline Torch.—The Vulcan torch, placed on the market by the Central Electric Company, Chicago, is noticeable for the simplicity of design and the marked feature of safety. Construction companies who may replace their present torches with the Vulcan will find that they have taken an economical step.

Arc Light Carbons.—Central station managers operating in Northern cities are wondering why their Canadian brethren are enabled to purchase carbons made in the "States" at a price ranging from 40 to 65 per cent. lower than the same quality of carbons are supplied here. If "firsts" can be profitably sold in Canada for five dollars per thousand, why ask more for the same carbons here?

The Columbian Intramural Railway Company.—Mr. Baker has prepared a statement showing that the operation of the road did not meet with the financial success expected. Nearly 6,000,000 passengers were carried, the monthly number increasing from 785,321 in June, to 1,575,000 in October. The largest number of passengers carried in one day was 126,000, on Chicago day. The 13 trains have been reduced in number to seven, and a further reduction will speedily follow.

The World's Fair.—Destruction reigns supreme in daylight hours, darkness and desolation at night. Every exhibitor desires to be the first to leave, and an army of packers, teamsters and inspectors are busily engaged in packing and removing exhibits. A week hence and all the smaller displays will be under way or prepared for shipment to distant points. In the meantime, many a bargain in furniture, machinery, and artistic and decorative materials is secured by cash purchasers.

Second-Hand Apparatus.—The closing of the World's Fair affords an excellent opportunity to secure bargains in small motors and dynamos, arc lamps and lamp fixtures, exhibitors being glad to dispose of the apparatus at any price within reason, provided cash is laid down and the purchaser assumes the responsibility of removal. Charles E. Gregory, of Chicago, has been fortunate in securing some of this apparatus, which he is cleaning up and rapidly disposing of at reasonable prices.

A Wire Measurer.—The Central Electric Company, 116-118 Franklin street, Chicago, is receiving orders for a simple wire measurer, that is one of the most convenient and useful articles to be found in the stockroom of large users of wire. The wire passes between two rollers, one of which engages with a geared counting device that indicates the exact number of feet that passes through the slot, and enabling the purchaser to quickly verify the measurement billed. The entire arrangement is automatic in action, with a recording dial similar to car registers.

Receiver's Reports.—An analysis of one report indicates that the machinery in the plant has been valued at a price far in excess of what similar machines of pattern could be placed in operation for. Deduct this difference, and the liabilities exceed the assets. The report from another receiver indicates that merchandise has been valued at far too low a figure, while the accounts receivable have not been carefully sifted. While the ultimate aggregate of receipts may be the same, the receiver will not lose credit by obtaining a higher price for the merchandise, while little blame will be attached for being unable to collect certain accounts.

The St. Louis Deal.—The Edison Illuminating Company, of St. Louis, having a capital of $4,000,000 and $4,000,000 in first mortgage bonds, has acquired the properties of the Municipal Electric Light and Power Company and of the Missouri Electric Light and Power Company, and will hereafter manage the business of the triple organization. The present officials will give place to others at intervals between now and the new year. Mr. Campbell will probably retain an active interest in the new management, and a resident of St. Louis will be elected to the presidency. The Municipal plant will probably form the arc light department of the new organization.

The Northwestern Elevated Railroad Company has been incorporated with a view to securing a franchise for operating an electric elevated railway line on the north and west sides of the river in Chicago. The plans will not be definitely formulated until the right of way is secured, and then the best system for the purpose will be the one selected. Whether the motors will be operated by accumulators, or by a third rail trolley, remains to be seen. Mr. B. J. Arnold, who designed the power plant of the Intramural Railway, at Jackson Park, of the North-Shore Railway, and of the city railway, at Little Rock, has been appointed consulting engineer for the new company and will have the plans in his office in "The Rookery."

Gas Engines.—Mr. W. H. Cothren has entered the service of the Webster Manufacturing Company, 1075 West Fifteenth street, Chicago, as manager of the electrical department of the gas and oil engine branch of their business. The present Webster engines are particularly adapted for service in small electrical plants, the method of governing enabling incandescent illumination to be secured with as good results as though the dynamo was driven by a steam engine. This same principle will be applied to an engine for central station service. As is well known, Mr. Cothren was formerly connected with the Edison Electric Illuminating Company, of New York, the Edison General Electric Company and the Field Engineering Company, and is thoroughly up in all matters pertaining to lighting, power and railway work.

The Lamented Carter Harrison.—Foully assassinated at the close of Mayor's day, and on the eve of closing the World's Fair, for the success of which he had worked earnestly and practically, Mayor Harrison entered into his final rest at the height of his popularity. That few men had won the same respect for an earnest devotion to all that would tend to promote the best interests of Chicago, is clearly shown in the great outpouring of the people of all classes, both to view the remains, while lying in state in the City Hall, and while the funeral cortege was slowly wending its way to Graceland. A conservative estimate places the number in procession as exceeding 20,000, while more than half a million people lined the streets. Mayor Harrison was a warm supporter of all practical municipal improvements, more especially of rapid transit facilities, and the illumination of the streets, and it is the earnest hope of all good citizens that the construction of extensions, recently planned, may not be seriously retarded by this sad ending to an active and honorable career.

Chicago, Nov. 4. F. DE L.

OUR BOSTON LETTER.

The Town of Middleboro, Mass., has voted to purchase the plant of the Middleboro Gas and Electric Company, and take up municipal lighting. Bonds to the amount of $75,000 will be issued, payable in from 1 to 30 years.

At the recent annual meeting of the Pittsfield Electric Railway Company, Judge J. Tucker was re-elected president, and the treasurer's report showed that the road had made a good showing. Over $17,000 has been put into new construction.

A number of Boston capitalists are largely interested in a scheme for establishing a power plant for the transmission of electricity in the town of Conway, Mass. The site is admirably suited to the purpose, and the idea is to build a power house on the banks of the South River at a point about 450 feet below a natural dam, which is in itself an important factor in the enterprise. The fall from the top of this dam to the water wheels would be 198 feet, and at the head of the new pond is another natural fall of 30 feet, giving additional height and power. It is estimated that 2,000 horsepower could be obtained from this source, even in dry seasons. Electric power will be furnished to a number of large manufacturing plants in Northampton, and an electric road between Conway station and the center is also proposed.

The W. S. Hill Electric Company, of this city, have just secured another large order for special switch board work, in which line they are rapidly establishing a high reputation. Their latest contract calls for the construction of an eight panel board for the Narragansett Electric Light Company, to control the large alternating machines recently installed by the company for operating about 20,000 incandescent lights. The board will be constructed of Italian marble and will carry a large number of special switches designed by Chas. H. Herrick, electrical engineer of the Narragansett company. The W. S. Hill Company are making a special feature of switch and switch board work, their recent order from the Philadelphia Traction Company comprising some of the largest single switches ever manufactured. H. G. T.

Boston, November 4.

The Sheriff has levied on the office of the Essick Printing Telegraph Company at 1 Broadway, New York, on an attachment for $6,910 in favor of Frederick H. Wilkins for services as secretary. Abner McKinley, who exploited the company, is said to be a relative of the Ohio statesman.

Wall Street and the Electrical Stock Market.

Two great events have transpired in financial circles this week, viz., the repeal of the Sherman Silver Law and the other the return of the monetary situation in this center to its normal state, as marked by the retirement of the last of the $38,280,000 Clearing House certificates.

The repeal of the law, which has been so earnestly prayed for in trade and financial circles since August 1, has left financial writers in a sea of speculation as to the immediate effect. However, none of any note will question that the ultimate outcome will be of decided advantage to the country.

The reception of the repeal by Wall Street, as was evidenced by stock quotations, was decidedly chilly. Since Monday it was marked by a steady decline, which at the present writing continues. It is generally conceded that the repeal had for the time being been over discounted by the advance of the two weeks preceding, and that the decline after it went into effect was only natural. Last week the general public began to take an interest in the market, owing to its upward tendencies. When they saw the halt called, short stock put out and a disposition of those who had secured profits to realize, they withdrew, leaving the market in the hands of professionals, which consisted of an aggressive bear element and an unorganized bull support. The bears on Tuesday, taking advantage of these conditions, and aided by a selling movement from London, sold the market down to a point where stop orders on weakly held stocks, were caught. This caused a general shaking out and transfer into stronger hands of securities, and the creation of two distinct parties in the market. At this time the market is almost entirely professional, largely oversold, narrow and decidedly uncertain. The bears have found it incompatible with safety to put out many more stocks, as they would be forced to buy them back at a higher figure. Both sides are now resting.

The various trade agencies say that thus far the effect of the repeal has only been felt sentimentally and in the financial situation. In the trade it is the general belief that it came too late to affect Fall trade. Conservative merchants admit that there is little prospect of the revival in the general demand this year.

In the electrical list, barring General Electric and Western Union, there were no marked features of interest. Like all inactive securities, they have suffered less than those of the list which are active, being held largely for investment. The electrical business throughout the country has suffered very materially in the panic and it will be some time before a complete restoration takes place. The large manufacturing companies are doing business at a less price, have curtailed expenses to the minimum, and are looking more sharply after orders than ever before. This leads to keen competition not compatible with large profits. Officers of these concerns inform us that their orders for new goods have fallen off materially, that their supply business has increased largely. This is most suggestive as showing the condition of various power and lighting companies, indicating that they are tiding over the depression by repairing and patching up their machinery rather than replacing it.

In the stock market Western Union reached the highest prices on Monday, fluctuating around 94. There is undoubtedly a bull pool working in this stock, or at least was working on the date in question. Since that time the stock gradually slumped, touching 87¼ Friday. On Tuesday there were signs that a large block of stock, weakly held, was dropped causing a general outpouring of holdings on the decline. The bears were aggressive in the stock, accelerating the movement. The sentiment in the Street in regard to this security is about evenly divided. One contingent holds that 90 for a 5 per cent stock at the present time is too high. The other points to the fact that the Company earned 6 per cent. last year on its entire capital, $5,000,000 of which is in the Treasury and does not call for dividends. It has practically no bonded debt and in consequence is as good an investment as the bonds of most railroads. When Western Union crossed par before there was no investment selling of importance, while the decline to 67 brought an amount of investment buying which took more than 50,000 shares of stock out of the Street. There is much less Western Union in the Street to-day than there was when stock was at par before.

General Electric declined during the week from 51¼ to 44⅞. A thing most unusual for this stock was an utter lack of bear rumors, such as have been current all Summer. This may be construed as favorable, if in no other way, at least in indicating that the bear campaign is about over. The strength last week in the stock, which carried it to the highest figure since the decline to 30, was undoubtedly due to rights which accrue to shareholders, under the plan for caring for the floating debt, as fully set forth by us last week. We do not regard the decline of this week as being especially significant, but believe that it was caused by realizations, some short sales, the reaching of a few stop orders, and the undesirability of holding an undividend paying stock. The 5 per cent. bonds of the company were quite active around 80½ and 81.

Edison Electric Illuminating sold in two small lots around par. This stock has now fully recovered from the depression caused by the financial difficulties last Summer, of the house which was a large holder thereof. The bonds sold at 104¾ to 105.

North American was without feature at 5½ to 5⅝. It is now the generally accepted view that the company has liquidated largely of its own desirable assets, and that its future is not promising.

On the Boston Stock Exchange Bell Telephone showed some weakness on limited sales, dropping to 192 from 195. The highest point of the year was 212, on January 27th. Erie Telephone was steady at 43. New England Telephone was firm at 55. Westinghouse preferred was bid 46½. Fort Wayne Electric did not receive a bid.

The following table gives the range of prices on the New York Stock Exchange in those securities which were traded in:

	High.	Low.
Western Union	94	87¼
U. S. Collateral Trust, 5's	103½	102
General Electric	51¾	44⅞
Edison Electric Ill	100	99
U. S. 1st 5's	105	104¾
American Tel. and Cable	89¼	86½
North American	5½	5⅝

November 4, 1893.

"Business Rapidly Improving."

A BIG ENGINE COMPANY REPORTS A BRIGHT OUTLOOK.

The Armington & Sims Engine Company, of Providence, R. I., one of the largest and most successful engine manufacturers in this country, is again in receipt of big orders for the popular Armington & Sims engine. Under date of November 2, 1893, Mr. Gardiner C. Sims, the general manager of the company, writes to the Editor of the ELECTRICAL REVIEW as follows, and we think the experience of his company will soon be the experience of other enterprising manufacturers in this and other lines:

"Business with us is rapidly improving, and we have had more inquiries in the last two weeks than in the previous three months.

"Collections are better and the prospect rapidly brightens."

The REVIEW would be pleased to receive and publish other encouraging experiences. We think a little confidence and enterprise will do wonders in advancing the best interests of the country and bringing the industrial situation back to its normal condition.

The Metropolitan Electric Company, of Chicago, Wm. H. McKinlock, president, has removed its offices from the Manhattan Building to more commodious quarters at 523 and 523 Monadnock Block, the well-known office building, which is one of Chicago's wonders.

Electric Traction in Germany.

Electric traction continues to make good progress in Germany. An electric tramway is about to be constructed in the town of Plauen, the contract for the work having been secured by the Allgemeine Electricitats Gesellschaft, of Berlin. Some difficulties have been placed in the way of the proposed Braunschweig-Wolfenbüttel Electric Tramway by the Braunschweig Tramway Company. An electric street railway is to be constructed between Schleiz, Ziegenrück and Erchuht, Saxony. The contract has been secured by Messrs. Siemens & Halske, Berlin. The same firm has just entered into a contract for the construction of the following electric tramways in the Westphalian mining district: between Schalke, Gelsenkirchen, Weckendorf, Wattenberd, Centrum and Boehurn; a line between Gelsenkirchen, Wanne, Eickel, Riemke and Herne; a line between Gelsenkirchen and the Bismarck railway station, and one between Gelsenkirchen and Steele.

A company is being formed to construct and operate an electric street railway between Düsseldorf, Hochfeld and Duisberg. The necessary plans are at present under the consideration of the provincial authorities. Plans have been prepared by Messrs. Siemens & Halske, of Berlin, for the construction of an electric street railway in that city between the Central Cattle Yard and the Warsaw Bridge.

Commercial Cable Company Wins a Prize.

The Commercial Cable Company has received at its main office, No. 1 Broadway, this city, a blue ribbon, preliminary to the delivery of a medal from the World's Columbian Exposition officials, awarding them the prize for the best improved ocean telegraph apparatus.

The ribbon is of blue satin, 18 inches in length, with a gold fringe depending. On it, in gilt letters, are the words:

Chicago, 1893. Official ribbon issued by the authority of the World's Columbian Exposition, George R. Davis, director general, John Boyd Thacher, chairman, Committee of Awards. Department F, machinery, L. W. Robinson, chief. Premium awarded system of operating ocean telegraph cables, Cuttriss' improved cable and telegraph apparatus controlled and operated by the Commercial Cable Company, No. 1 Broadway, New York.

This is the second prize of the kind awarded the Commercial Cable Company. At the Paris Exposition in 1889 a silver medal was awarded to the company for a siphon recorder and accompanying vibrator. In the Chicago exhibit by the company were improvements on the exhibit at the Paris Exposition, chief of which was an improved automatic sender.

Kindly Mention of a Gentleman Prominent in Electrical Circles.

The *Journalist*, of New York city, has a department devoted to "Rail, River and Ocean," edited by W. Blackstone Hopson. In a recent issue appears the following mention of a gentleman widely known in the electrical field:

Mr. C. O. Baker, Jr., of the firm of Baker & Company, of Newark, N J., refines gold, silver and platinum in Newark, and has various railroad interests in New York. He is a familiar figure at the office of the American Travelers' and Tourists' Company, 849 Broadway. From a photograph my detective makes the following estimate of his character:

Strong and well-shaped ear, showing good business capacity coupled with long-headedness. Social and agreeable in all his business relations—honesty and social integrity not to be doubted. First-class mental organization fitting him for almost any position. Considerate of others' feelings, and despises a "business" or "social" bore. Is a most excellent listener, and what he has to say is expressed in a few words and to the point, without the least show of brusqueness. Possesses the "perfect eye," showing that his word is his bond under all circumstances.

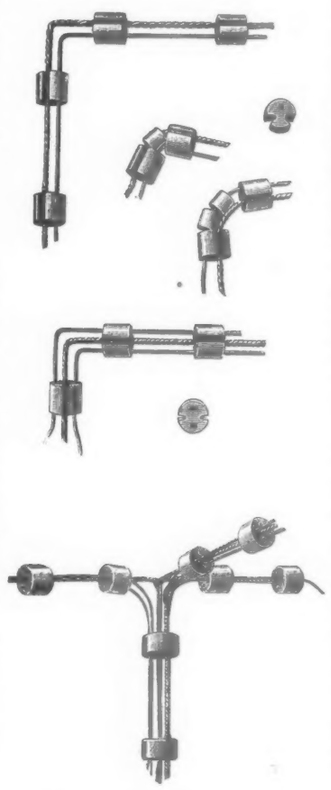
Electric Traction in India.

Work has been commenced in connection with the construction of the car shed, engine and boiler houses and power station for the Madras electric tramway.

A Mechanical System of Electric Conductors.

These conductors were designed by Messrs. Cooke, Smythe and Payne, and the following information was given in a paper, read by Mr. Ernest Payne, before the British Association, with the object of providing a system that should be free from the objection sometimes urged against the covered wires and wood casings, that they are not composed of fire-proof and imperishable materials, like the water pipes, gas pipes and fixtures used in the interiors of houses and public buildings. For the facts and the illustrations we are indebted to the London *Electrical Review*.

The first conductors used were arranged on the concentric principle and consisted of tubes placed one inside the other and separated by means of insulating rings (usually of porcelain) placed at intervals along the tubes, or by means of porcelain studs fitted into small holes made in the tubes at intervals. There were also designed a number of junction boxes and supports for holding the conductors and fittings connected with them. These boxes are made usually in two halves, so that they can be fitted round the ends of the tubes after the joints are made in the conductors.



A Mechanical System of Electric Conductors.

When the boxes are not employed, L and T-shaped junctions are used; a large variety of these have been made, some of castings and others of stampings made with press tools.

For breaking the metallic continuity of the outer tube, which is not used to carry current, an insulating support may be employed; another is made to work with ceiling roses, switches, cut-outs, etc., of the usual types. The fixing of the insulators to the conductors was the chief mechanical difficulty to be overcome. It was the firm's object from the first to fix the insulators to the conductors in the workshop and send them out ready for erection. By employing a tubular strip of copper, not brazed or soldered along the edges, the insulators were fixed to this either by forcing them inside or outside, as required, the rings being held in position by the spring of the metal. This was improved upon by making the inner and outer insulators of such sizes that an outer ring would not pass along over a point where there was an inner ring inside the tube, so that they could be pushed inside and outside alternately, and hold firm by the mutual inward and outward pressure against the tubular strip. The inner and outer rings were thus fixed to the middle tube, after which a central wire or rod could be pushed through the holes in the inner rings, and the two together placed inside the outer tube or guard. This formed a very rigid combination and there was no chance of earths or short circuits. Several of the concentric circuits in the offices of the City of London Electric Lighting Company are arranged in this way.

By employing two strips of semi-circular section, and providing the insulators with projections to keep them apart, the outer conductors form two circuits and the inner rod can be used as a common return. This arrangement is also suitable for vertical mains when arranged on the three-wire system.

Numerous experiments were made with a view to devising some good methods of fixing the insulators to ordinary copper wires, and the firm adopted the plan of making the insulators with holes or grooves in them, so that the wires could be drawn through the holes or laid along the grooves and the insulators fixed by twisting the wires together; other conductors, wires, strips, etc., can then be drawn through other holds of suitable size and section for other circuits. The wires and insulators can be made up in long lengths, and sent out coiled up like the usual covered wires; the outer tubes can be cut and erected separately, and the wires drawn through afterwards, or they can be sent out complete with the wires inside. In the latter case, nearly all the work can be completed in the workshop, which is very advantageous where work has to be done in business premises and cannot be carried on during the daytime.

In some cases it is convenient to make a joint in the conductors separately, and then joint the longer wires to these and cover them with sleeves; these junctions can be made up in numbers and kept in stock.

The multiple mains form a very prominent feature in the system. For supplying current to the different floors of a building, for flats, hotels, etc., a separate wire can run up from a distribution board to each floor, all enclosed in one tube. The central return can also be stranded, one or more being dropped at each branch. No soldered joints, therefore, will be necessary.

The L and T junctions, and also the junction supports, already described, can be used in combination with the wires or with the concentric tubes.

When the exact position of a bend is known, and very careful insulation is wanted, small insulators can be threaded on the wires at the bend.

Where necessary, an insulator with two or more grooves in it, according to the number of wires, can be inserted exactly at the bends if it is found necessary. Messrs. Cook, Smythe and Payne have also designed several insulating junctions for the tubes, made, usually, in two parts for L's and three parts for T joints. They are fitted on round the wires, and provided with semi-circular projecting parts that fit inside the ends of the tubes, which are pushed on to them, and thus hold the two parts firmly together.

With regard to the insulation of these conductors, it should be pointed out that when bare conductors are employed for interior wiring, the difficulties met with are not so hard to overcome as those encountered in underground conduits. The interior of a building is usually dry, the temperature generally higher than that of the air outside, and it has been found, after two years of practical experience, that one does not get the condensation that is sometimes said to take place when warm moist air finds its way into a cold conduit. In the case where rows of lamps are fitted on tubes and used for shop windows or stage footlights, the heat of the lamps causes circulation of warm air round about the insulators and keeps the insulation up at a high figure.

Special Paper on "Traction and Street Railway Trucks."

READ BEFORE THE MILWAUKEE CONVENTION OF THE AMERICAN STREET RAILWAY ASSOCIATION, BY ELMER H. SPERRY.

As street cars upon the thoroughfares of nearly all of the large cities in this country are rapidly being equipped with means for self-propulsion (becoming, in fact, locomotives of sufficient power to successfully handle, in addition to themselves, other cars as trailers) and, furthermore, inasmuch as these cars and trains are mobilized upon street surface tracks and subject to the peculiar conditions thereby entailed, data, tests or deductions throwing light upon the subject of traction in general, and especially under the conditions of street service, are considered timely and important. The installation of a motor upon a street railway or other track is really for the sole purpose of utilizing the tractive or adhesive effect of the wheel upon the rail. The writer has for some years made a special study of traction, having had opportunities for observation and test upon steam and electric surface roads, and also under the peculiar and very severe conditions of mine haulage traction, which latter has proved a fruitful source of information.

In the popular mind the laws governing traction or adhesion are entirely divorced from those governing friction. This view is not correct. The adhesion between the wheel and rail is really friction of quiescence. In studying the laws governing both friction of quiescence and friction of motion one is struck with a peculiarity in the curves; notably so when metallic substances are undergoing examination. The characteristic relates especially to a remarkable drop, consisting in the member constituting practically a vertical line between the readings taken before and after slipping commences between the metallic substances under test. The curve shown in Fig. 1 is taken as between a rail and wheel supporting about 3,200 pounds. The most cursory examination of the curve will at once show that the characteristic is by no means one of gradual or proportionate transition from a state of quiescence to that of motion, but, on the contrary, a breaking away with a wonderful suddenness of drop from high values to those which are very low.

Without recounting other experiments which have forced me to the following deduction, I will state that, in my opinion, what we know as friction of quiescence or adhesion between a wheel and a rail consists essentially of molecular gearing, the teeth of which, though minute, are as positively in mesh as those of the regularly organized gear. Whether they be in fact the molecules of the chemist is a question, but they are certainly the interlocking of the minute irregularities of the substances. These I have found to be maximum when the substances are alike, under these conditions the aforenamed molecules or irregularities probably being very similar as to dimensions. By this statement it is not meant that the highest values are necessarily attained under conditions of like materials, but that the lines connecting the higher and lower values are more nearly vertical, arguing more complete intermeshing, hence in shearing a more sudden giving away of the molecular teeth at the time of dropping from the high to the lower values or co efficients. The curve in question is drawn to scale, and graphically portrays the extremely low values in terms of traction or drawbar pull, upon the dynamometer of the slipping wheel, as compared with the wheel rolling upon the track without slip. This curve was obtained in determining by trial the grade at which forwardly revolving slipping wheels would just balance the tendency of the weighted car to slide down the grade. Space does not permit multiplying data and curves, all of which prove the importance of preventing the slipping of traction wheels. The insight afforded by these curves leads to revelations which are at first startling to the investigator, and in the judgment of the writer the present investigation should be followed by others in this most important field. The curve shows the instant of starting to slip to be the critical point, and the problem is preeminently one of preventing the wheels in question from starting to slip.

How can this be best accomplished?

The writer has made a number of tests which may be of interest in this connection, and which show that there is a possibility of improvement upon methods which we at present accept as a standard. The oldest method of accomplishing this purpose has been to couple all the drivers for absolute harmony and uniformity of movement, so that the tendency to slip of one driver will be held back by all the others instead of by its mate only. The question being, Do we find in practice the coupling of the wheels in this way to accomplish the desired result? Does it in any way increase the traction?

Experiments have been made to determine this question, including a bi-axled equipment of the ordinary kind, with an independent motor for each axle, and also equipment consisting of four, six, and as high as eight separate drivers locked together and compelled to revolve in unison, being supplied with a single motor or source of power. I have found the method employed in coupling the wheels to seriously affect the traction, appearing as a drawbar pull.

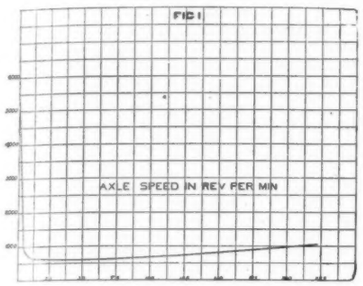


FIG. 1.—TRACTION AND STREET RAILWAY TRUCKS.—TRACTION CURVE.

For instance, if locomotive connecting rods are used, the necessary flexibility of truck as to parallelism of axles must be either entirely sacrificed, or, if allowed to exist, it produces a continually and constantly recurring tendency to slip, resulting in a change from compression to extension of all the strains in both the truck and connecting rods. This change occurs twice in each revolution of the system, and results in a slip alternately of the wheels upon each side, in amount dependent upon the lost motion existing. I have seen experiments where this periodic slip amounted to as much as five-sixteenths of an inch, occurring twice each revolution, when working upon a grade without trailer.

This is avoided by steam locomotive engineers by holding the axles in absolute parallelism in plane normal to the road-bed; and until within the last few months English locomotive builders have maintained that the parallelism of driver axles should be absolute; that is, parallel to every plane.

As to the street car truck, the flexibility necessary argues the employment of belting or rope transmission, which easily and naturally permits of such flexibility. I am free to say that no one, who has not tried this experiment, can form an adequate conception of the tremendous strains which motor gearing is called upon, at times, to withstand. I have seen as high as 14 parallel laps of rawhide rope, under very heavy tension, in 45 degree grooves, slip and burn in their efforts to do work under conditions where gears are ordinarily employed, the gearing doing their work with perfect ease. No form of friction drive or friction gearing is admissible for this work. The chain drive was the first to be employed in this country, but was early abandoned on account of noise, excessive wear and journal strains, together with the impossibility of keeping it anything like adequately lubricated.

As to gearing between the axles, the bevel gear presents by far the simplest solution. This form of gearing, however, has been

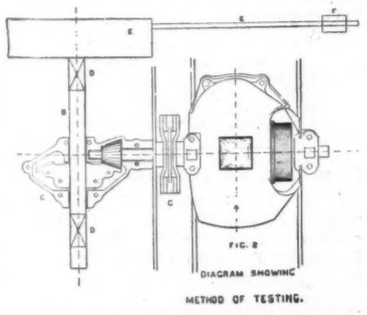


FIG. 2.—DIAGRAM SHOWING METHOD OF TESTING.

looked upon as wasteful of the power transmitted. This criticism is probably just in some power transmissions employing this gearing. The question is, how much more power does a bevel gear and pinion absorb than a spur gear and pinion in transmitting the same amount of power, with the conditions identical? There seems to be almost no scientific or carefully made tests of merit as to the comparative losses in transmission of power by these two classes of gears. Fig. 2 shows a diagrammatic view of an apparatus designed by the writer for testing this feature, with which an exhaustive series of tests covering this point has been made. B is a car axle mounted in journals, D D. E is a hydraulic dynamometer, with lever arm, E, and weight F. A is an electric motor delivering its power to a pinion co-operating with a gear mounted upon the car axle, B, C being a flexible connection as between the motor and the pinion shaft. The car axle was 3⅜ inches in diameter, and two sets of gearing were employed as between the axle and the motor. First, the bevel gear and pinion (shown in the diagram) inclosed in an oil housing, G, which were alternated with the test of spur gear and pinion, also mounted within an oil housing, when the spur gear was used, the motor being set around at right angles to its position, as shown in the diagram, and parallel with the axle, B, and connected with the shaft of the spur pinion. The spur gears were 4½ inches face, cut in steel,

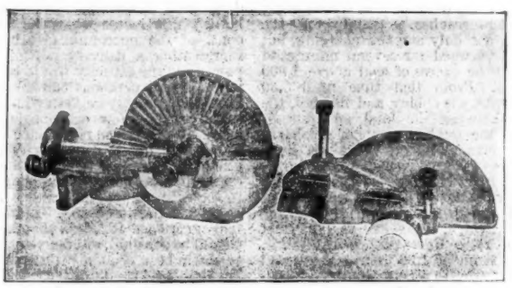
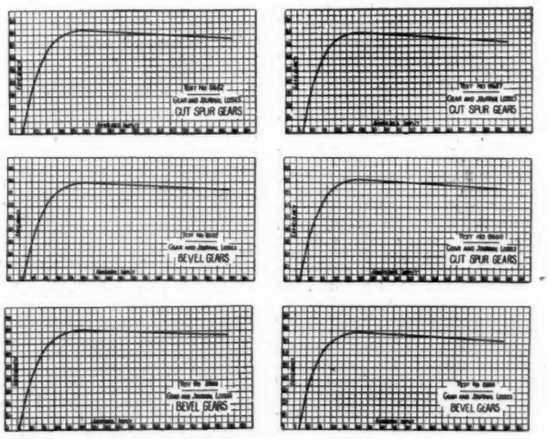


FIG. 3.—BEVEL GEARS AND OIL HOUSING.

finished on an Eberhardt machine with Brown & Sharpe cutters, running in an oil-tight casing, in which three-quarters of a gallon of oil was placed. They were accurately placed on pitch line and running very easily and smoothly. The bevel gears used were turned out by the Walker Manufacturing Company, the test in question being used to ascertain the best shape of teeth for the work. The bevel gear was five and a quarter inches face, the teeth were uncut, and of coarse pitch cast very smooth and double shrouded, the pinion being cast-steel, uncut, and five inches face. The bevel gears and oil housing are illustrated in Fig. 3. It will readily be seen that the conditions under which these tests were made were as nearly alike as it was possible to make them, and at the same time the transmissions were worked under the same conditions that obtain when mounted on a street car truck. Numerous curves were plotted, showing the total losses from the electrical terminals of the motor to the dynamometer, showing gear losses, losses resulting from shoulder and journal strains produced by the gearing, and all the bearings in each test through the entire range from starting to about 60 horse-power input. Submitted herewith, in Figs. 4 to 9 inclusive, are curves showing that under practical working conditions, when the bevel gear is properly made, the losses are almost identical with



FIGS. 4–9.—BEVEL GEAR CURVES.

spur gear; the small difference, viz: 17.4 per cent. in favor of the cut gear probably being due to the fact that the surfaces were somewhat rougher in the cast as compared with the cut gear. The great care exercised in these tests, and the clearness of the results, certainly speak volumes in favor of the bevel gear transmission, and constitute the first comparative tests of large transmissions under heavy strains which, to the knowledge of the writer, have been made.

Another feature bearing directly upon the all important question of traction is that of axially mounted masses. Locomotive drivers and axles are as light in and of themselves as is consistent with required strength. The inertia of a large mass axially mounted does not allow the drivers to follow the surface irregularities of the track with anything like equal pressure, especially at high velocities. The wear and tear of road-bed is also due, in large measure, to the heavy masses attached directly to the axle. All weights of magnitude should be spring supported. In this connection it has not before been pointed out that it is largely immaterial whether the axle is compelled to carry much or little of the weight of the mass so long as such mass is solidly and unyieldingly attached thereto, inasmuch as the axle is compelled to follow the laws of falling bodies controlled by the weight and inertia of the mass as a whole.

Referring now to the tests, a grade was built consisting of 45 pound T rails raising from a spur of level track, giving a mean grade of the two rails of 12.24 per cent. Upon this grade was run, first a double motor equipment weighing 17,935 pounds. A dynamometer was attached to the drawbar and back to the track in such a line as not to either lift the car or drag the rear end downward in the test. Current was then applied through a variable resistance, gradually allowing the car to strain upon the dynamometer until finally the wheels slipped. Care was especially exercised on the point of gradual application of the strain so as to eliminate all elements of inertia or lunging forward upon the dynamometer; after slipping had commenced it was observed that the car would slide in each instance to the bottom of the grade. The following table gives the mean of four sets of readings:

INDEPENDENT AXLE, TWO MOTOR EQUIPMENT.

Drawbar pull on dynamometer. Car standing on 12.44 per cent. grade; Weight of equipment, 17,935 pounds.

Group of Tests.	Average Amperes.	Average Drawbar Pull.	Ratio Drawbar Pull to Weight.
1	1,625	200 lbs.	9 per cent.
2	2,250	280 "	12.5 "
3	2,150	240 "	12 "
4	2,075	230 "	11 "

This car was run off the grade and replaced with one in which all the wheels were compelled to revolve in unison, but of much lighter weight, viz., 12,685 pounds. The dynamometer was attached in the same way and the same rheostat and source of current was used as in the previous experiment, the axles in this equipment being coupled by the bevel gears shown and described in connection with the gear tests above referred to. The following table gives the mean of five sets of readings taken from this car:

COUPLED AXLES, SINGLE MOTOR EQUIPMENT.

Drawbar pull on dynamometer. Car standing upon 12.44 per cent. grade; Weight of equipment, 12,685 pounds.

Group of Tests.	Average Amperes.	Average Drawbar Pull.	Ratio Drawbar Pull to Weight.
1	200	3,125 lbs.	24 per cent.
2	240	3,750 "	30 "
3	280	4,075 "	32 "
4	220	4,500 "	35 "
5	200	4,375 "	34.4 "

The same operator applied current to the car in both tests, and every condition of electrical pressure, track and water remained identical throughout. The accompanying photograph shows the car standing on the grade with dynamometer attached.

The car was then run off the track and the rails blocked, as is shown in Fig. 10, one rail being 12⅜ inches rise in 10 feet, the other being 17.2 inches, making a mean of 14.92 inches rise in 10 feet, equaling a grade of 12.44 per cent., giving a warp of considerable magnitude to the road-bed. The reason for this may be explained in a word, as follows: It has long been known that the successful railway truck must provide for great flexibility and lost motion in almost every plane. The axles must be afforded independence and freedom of movement endwise in a horizontal plane, and also in a vertical plane. They must be able to divide the load almost equally upon any reasonable irregularity of track. The axle flow in a horizontal plane must be universal for the purpose of taking short radius curves with ease and certainty, and without strain to truck or road-bed. The problem has been to fulfill these conditions, and still preserve absolute alignment of gears which are used in part as coupling for the axles, leaving the truck parts, in fact, just as free to take up any of their erratic positions as in the double motor equipment. The warping of the road-bed, shown in Fig. 10, would at once develop any rigidity introduced into the truck by the coupling, and show up materially in the ratio

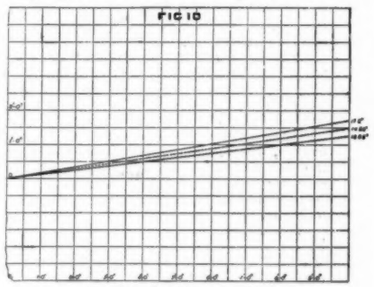


FIG. 10.—SHOWING WARP IN ROAD-BED.

of drawbar pull to the current absorbed if the equipment or any part was bound, unduly strained, or working under any but perfectly normal conditions. The following table shows the readings taken, and is conclusive as to the prefect freedom of the truck while working in this warped and highly distorted position.

COUPLED AXLES, SINGLE MOTOR EQUIPMENT.

Drawbar pull on dynamometer. Car standing upon warped track: Right rail, 14.33 per cent. grade; left rail, 10.58 per cent. grade; weight of equipment, 12,685 pounds.

Group of Tests.	Average Amperes.	Average Drawbar Pull.
1	230	4,425 lbs.
2	220	4,375 "
3	200	4,150 "
4	220	4,275 "

After slipping commences the tractive value of the front motor becomes almost *nil*, as shown by the tractive curve in Fig. 1, the work being undertaken almost entirely by the rear motor. Whereas, with coupled drivers, and especially where a single large capacity motor is used, the additional weight upon the rear wheels gives additional tractive power to these wheels, and the motor is compelled to deliver all its power to this pair if the exigency requires. At the same time the front wheels, instead of slipping, are compelled to revolve in step with the back wheels and bite the rail in unison therewith, and in fact all the wheels are held down to the business of effective non-slipping adhesion, this being true in whichever way the car approaches the hill, and whichever pair of wheels are respectively forward and rear. This great difference in favor of coupled drivers shows a percentage of 35 as compared with 12.5 of the total weight appearing as actual pull at the drawbar under the conditions named. While working upon a level, and especially in damp weather with a slimy rail, almost the same advantage in traction will be found to exist as is here given for coupled wheels, provided always the mechanism used in coupling does not interfere in the least with the flexibility of the truck.

The Use of Storage Batteries in Electric Generating Stations for Utilizing and Regulating Power.

(Concluded from page 127.)

Let us take, for instance, the load diagram n Fig. 1, which shows by calculation a total output for the day of 23,260 horse-power hours. Actual tests made at this station show a steam consumption of some 21.5 pounds per horse-power hour with engines (compound condensing) that would easily do the same work with 16½ pounds, or five pounds less, if doing this work at uniform, steady rate. Here, then, is a case where the highest engineering skill and material have apparently been used, with a view to securing the highest economy, where, in a word, the conditions are probably more favorable than in three-fourths of railway power stations, taken as they come, and yet the fuel consumption is still some 30 per cent. greater than might be. This means for the whole output of the day 116,300 pounds more of water to be evaporated, equivalent, as the boiler tests indicate (9.8 pounds steam per pound of coal), to 5.3 long tons (2,240 pounds) of coal.

Your committee finds in the same paper* some valuable corroborative evidence of the great influence which the character of load has on the efficiency of the engine. In a station where the steam consumption was found to be 29.2 pounds per horse-power hour under the conditions of the actual service, the authors found that it was only 22.5 pounds when the same engines were run on a steady, constant load, which they specially provided and arranged for the test. The (compound) engines in this case are of a type which is claimed to be more efficient than most others, under the fluctuating loads. Yet the steam consumption on fluctuating loads is still about 30 per cent. higher than it would be on steady loads. One might well shudder to think what the steam consumption must be in stations not having such efficient machinery.

Turning now to the storage battery as the proposed remedy for these evils, it is apparent on business principles that one wants to use as small a battery as will serve the purpose, for it is an expensive medicine, owing to its high initial cost and to its depreciation, which, though low enough in lighting stations, must be taken higher in this case, for the present at least, and until practical results in railway power stations have indicated the exact percentage to be taken.

We must first determine the battery factors. In railway power stations the rate factor will usually be much larger and the quantity factor much lower, relatively, than in lighting stations. Hence the size of a battery required is more apt to depend on the rate factor, while in case of lighting stations the reverse is usually the case.

It may happen, indeed, that although the actual capacity needed is quite small, a larger battery must be used, nevertheless, simply because the smaller one could not be charged or discharged at sufficiently high rates. In lighting stations, on the contrary, if the battery has the requisite capacity its rate factor is generally (not always) adequate for the case. As the extreme rates of charge and discharge would be either momentary, lasting from a second to a few minutes, in batteries used on railway circuits, a much greater latitude could, doubtless, be allowed in this respect. Taking the current rate for seven-hour discharge as normal, it is the opinion of your committee that these rates could be safely doubled for short periods. Provisionally, however, a rate corresponding to four-hour discharge may be taken. This establishes a relation between the rate factor and the quantity factor, for, in order to be able to count upon a certain rate of delivery we must provide a capacity sufficient, in every case, to maintain this rate for four hours. Hence, given the rate of delivery in kilowatts, the battery capacity in kilowatt hours must be four times that number; or given the capacity, the highest allowable rate will be one-fourth that number. In Fig. 1 the line B represents the load which the engines would carry to do the same work at constant and uniform rate, working 20 hours per day, instead of 22. This mean load in 1,168 horse-power. For 22 hours it would be about 1,057 horse-power. In order to be able to run the plant continually at either rate, the battery must be adequate in capacity and in rate to supply all the power necessary when the "waves" rise above the mean load, and it must be capable of absorbing all the energy required to keep the load up when the waves or "billows" fall below it, especially at the beginning and end of the run. It is easily shown that under such conditions the annual cost of the battery would be greater than the annual value of the gains derived by its use. Let us see, however, if the conditions can be varied slightly so as to reduce the cost of battery and still retain its advantages as a load equalizer and compensator. We will assume that the plant is to be run 20 hours per day (two shifts of 10 hours), starting from 5 A. M. with about 800 horse-power and running for an hour; then running from 7 A. M. until 10 P. M. at 1,300 horse-power; then running again at 800 horse-power until 1 A. M.—the end of the station run. The cars running after the plant stops, or during the night, and those running before the plant starts, would draw their current from the storage battery, a feature not without its merits. When the plant would start at 5 A. M. it would deliver some 500 horse-power into the batteries, the rest being sent out direct on the lines. By 6 A. M. the lines would absorb about the whole 800 horse-power, and, consequently, the generating output would be raised to 1,300 horse-power, which point the load soon reaches, so that by 6.30 the battery has not only stopped charging, but has even discharged for several minutes to take care of the excess of load above 1,300 horse-power. From that time until 5.30 P. M. the battery is ebbing and flowing, the difference between the total amounts of charge and the total amounts of discharge being very small. About this time, however, the battery would begin to discharge, and by 6 P. M. it would be carrying the 450 horse-power load, that being the excess of total load (1,750 horse-power) above the engine load, which, it is stated, is to be kept constant at 1,300 horse-power. At 9 P. M. the load falls under 1,300 horse-power and the battery begins to receive a charging current again. From 10 to 12 P. M., the output being reduced to 800 horse-power, the batteries will, as the curve indicates, charge and discharge in turns. From 12 to 1 the batteries will be mostly charging.

The quantity factor, by calculation, is some six per cent.; or, if we selected a battery by this factor, it would have a capacity of six per cent. of the total daily output (23,260 horse-power hours), which is about 1,400 horse-power hours. The rate factor is about 27.8 per cent. of the maximum rate (taken at 1,800 horse-power). This is 500 horse power, and at the least capacity allowable will be four times that number; the resulting capacity required is 2,000 horse-power hours. Therefore, the battery factor compels us to take a capacity some 43 per cent. greater than the quantity factor shows to be actually needed. This means in practice the battery will not be discharged fully at any time except in emergencies, for which it has a reserve sufficient to carry a load of 500 horse-power for over an hour. A capacity of 2,000 horse-power hours is theoretically equivalent to 1,492 kilowatt hours, but as a horse-power hour, at the engine, would represent not over .85 electrical horse power hours, it follows that the practical equivalent capacity of battery is 1,275 kilowatt hours. Taking the cost purposely at the highest figure, 65 cents per kilowatt hour, the initial cost of battery of 1,300 kilowatt hours, erected, will be $8,450. The depreciation at 15 per cent. and interest at 6 per cent., or in all 21 per cent., will make the annual cost $1,775, or $4.86 per day for a year of 365 days. The estimated savings of this case, in consequence of making the load steady, was equivalent to 5.3 tons of coal. The battery, however, will add, to the total energy produced, enough to cover the energy, less which it introduces. The battery supplies 6 per cent. of the energy at a loss of 75 per cent., which means 4.5 per cent. of the whole energy produced. The plant will, therefore, have to generate some 24,380 horse-power hours, instead of 23,260, representing 18,315 pounds more steam and 1,869 pounds more coal. The net saving would, therefore, be about 4.47 tons. In a station already built, such as this one, the only saving is that in coal. If coal cost less than $1.10 per ton the project would not pay; at $2 a ton it would effect a saving of $2.08 per day, and a corresponding amount at other prices. In the case of a new station, however, the saving would be materially greater, for it would include the interest on a certain capital that is economized in the equipment. Instead of a maximum capacity of 2,200 horse-power assumed here, the plant need not be built for more than 1,560 horse-power capacity to do the same work. We have a saving in the cost of 700 horse-power, amounting to probably at least $7,700, the interest and depreciation on which, taken at a low figure, 12½ per cent. for the two, amounts to $962 per year, or $2.64 per day.

In many cases the problem is slightly different. The road has developed and extended until the power station capacity is overtaxed. In many such instances calculation based on a full study of the conditions involved would probably show that the increased capacity could be obtained more cheaply by simply adding a storage battery to the station, the fact being that the station capacity is really large enough already when once the fluctuations are disposed of. In many such cases it will doubtless be found that, owing to the gain in efficiency, the cost of power would not be much increased, if at all; and in a few cases where the efficiency is now desperately low, it might even cost less for more cars.

Your committee has selected the example given for a detailed case, first because the data obtainable regarding it are more complete than for any other case; second, because it has been always considered that a road of 150 to 200 cars was a "limiting" case, where the storage battery was likely to be of little if any utility.

The smaller the station the more perceptible the effect on the efficiency will of necessity be. The quantity factor becomes smaller but the rate factor is usually larger, until on small roads of 10 cars and less it may amount to 60 per cent.; the load itself sometimes running up to two and a half or three times average value.

In the case shown in Fig. 3, of which the data are unfortunately incomplete, the battery rate factor would be about 55 per cent. of the maximum (400 horse-power), representing a delivery rate of 220 horse-power and the capacity would be 880 horse-power hours or about 558 kilowatt hours. It would probably be better in this case, as there are only few extreme jumps in the curve, to reduce the rate factor and depend on the engine to rise in capacity 10 or 15 per cent. when such extreme loads occur. By doing this the rate factor could be reduced to 25 per cent. and the battery capacity to about 260 kilowatt hours. It may be in fact that experience will show that the rate factor should be constant, or nearly so, for all cases, to obtain best economy (least annual cost) Under these conditions the battery would involve an expense of only 78 cents per day for interest and depreciation. The engine capacity need not exceed 180 horse-power; the load would be about 180 to 185 horse-power, except for the early and late hours of the run, when part of the plant would be shut down, as in the first case considered. The daily output is about 4,000 horse-power hours, to which may be added about five per cent. for loss due to the battery, making 4,020 horse-power hours. The saving effected, by reason of steadier load, would be in the neighborhood of a ton, according to the engine used. The hours of running could also be shortened to 20, as in the previous case.

WATER-POWER.

The use of storage batteries is destined to important applications where water-power is used for railway power generation. In such cases, since the power costs relatively little, the gain in efficiency is not of so much moment as are the regulating quality and the ability to store energy. Where the supply of power is constant, but limited, the rate of consumption can never exceed the rate of production. The consequence is that in railway water-power stations either the potential fluctuates seriously or else a sufficient margin of available power must be allowed; which means that the power cannot be worked to the limit. With the storage battery, not only the turbine can be loaded to the full limit, but the load may even be greater, if there is sufficient time in the intervals between heavy loads to accumulate a reserve power in the batteries.

REGULATION.

The process of making storage batteries absorb from or give back to a circuit any desired rate of current consists merely in varying the working potential of the battery in relation to that of the dynamos or circuit to which it is coupled, same as a load can be divided up in any desired proportion between two dynamos coupled in multiple by simply varying their electro-motive force relatively to each other. In the case of storage batteries, unfortunately, the working electro-motive force is not the same when charging as when discharging; nor is it the same for different rates of current, or even for the same rate at various periods of the charge or discharge. Hence, constant adjustment is necessary. In lighting stations, the desired relation of working potential to control the charge or discharge is effected usually by putting more or less cells in circuit. This method would be inadequate for the fluctuations met with on railway power circuits, by reason of its lack of quickness and of flexibility. The means provided must be such as to make the change of relation adapt itself to every change of load, automatically, instantly, and to any desired degree.

This can be accomplished by introducing in the battery circuit B B (Fig. 11) a variable source of potential such as produced by a small dynamo A, to which the name "booster" has been given. In the figure the working current sent over the line L passes through the field magnet coil N (being suitably proportioned by a shunt T) and thus enables the fluctuations of load themselves to control the working potential of the batteries so as to produce any desired relation.*

SUB-STATIONS.

It makes little or no difference in the compensation action of the batteries whether they be coupled to the circuit at the station or at sub-stations located at various points at a distance from the station. There would result from the use of sub-stations a greater uniformity of potential over the whole system, and a saving in copper; but one must offset against this the extra cost of the space, the extra attendance and expense of such sub-stations. They may be warranted, for this reason, only in very large systems covering large and relatively distant territory; also in inter-urban lines.

CONCLUSIONS.

The investigation and study by your committee of the facts and data bearing on this subject, as outlined herein above, would seem to your committee to warrant the following conclusions:

1. Great progress has been made in Europe during the last two or three years in the manufacture and perfection of storage batteries suited for central station purposes.

2. Storage batteries have been introduced in a large number of electric lighting central stations on a large commercial working scale, as factors of reserve and regulation, with a view to securing economy of initial cost and cost of operation, with satisfactory financial results, as a general rule, which has few, if any, exceptions, so far as your committee could ascertain.

3. The benefits derived in lighting central stations from the judicious use of storage batteries are so valuable in individual cases that the possibility of attaining like benefits, even in lower degree, in railway power stations, would justify the investigation of their use by actual experiment where this can be done under favorable conditions.

4. While the conditions differ, and are essentially more severe in railway power stations, there is no reason apparent why storage batteries may not be used successfully and advantageously for the purpose of securing greater uniformity of potential at the station or on the line, or of promoting and improving the efficiency of the plant.

5. Even assuming the highest values for initial cost and depreciation of the storage batteries, the indications point to the possibility of realizing a gain in economy in all stations operating 200 cars and less, when coal is worth $2 per ton and over, while the economy will be much greater should the initial cost and depreciation prove actually lower in practice. Advantages are also secured, which, though not affecting the economy directly, do so indirectly by affording additional convenience in operation.

6. The indications are that in some cases a power plant could be built and operated at less cost by using storage batteries than without.

7. The capacity of an existing plant can probably in most cases be increased more cheaply by adding storage batteries than by adding more generating machinery, while at the same time the cost of operation will be reduced.

8. The question whether storage batteries are expedient and practicable, and to what extent, for any particular case, should be, and can only be, in the present state of our knowledge, determined for each case individually by a careful analysis of all the facts and conditions involved by a competent engineer.

9. Practical experience in a certain number of stations alone can lead to definite rules or indications in regard to the best size of battery, the best methods of regulation, the most favorable conditions of use, and like questions.

10. Perfection in the details of the use of storage batteries in railway plants will be the result of a certain evolution or series of improvements, same as in other details of the equipment of a plant.

Respectfully submitted,

C. O. MAILLOUX, *Committee.*

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*"Performance of Street Railway Power Plants," an interesting paper by W. A. Pike and T. W. Hugo, read at International Engineering Congress, at Chicago, August 3, 1893.

*For further details regarding this method see the *Street Railway Journal*, November, 1890, and June, 1893, and the *Electrical Engineer*, December 3, 1890, August 30, 1892.

Long Distance Telephony in Germany.

An important extension of the telephone system of Germany is at present being carried out by the establishment of a double line between Berlin and Cologne, a distance of about 395 miles. The line will run *via* Spandau, Rathenow, Spendal, Gardlegen, Hanover, Hameln, Paderborn, Büren, Meschede and Rönsahl. One wire will be reserved for direct communication between Berlin and Cologne, while the other will be used for communication between Cologne and Hanover, and between Hanover and Berlin. A bronze wire of four millimetres diameter will be employed. To cross the river Elbe it has been decided to lay a submarine cable about one and one-fifth miles long in the bed of the river near Langermünde, so as not to interfere with the shipping by erecting an overhead line. The submarine cable will only be paper-insulated, and as it is stated that this is the first example of the kind, the experiment is being watched with interest.

ADVANCE INFORMATION.

New Electric Companies Formed and Important Constructions Projected.

VALUABLE INFORMATION FOR MANUFACTURERS AND DEALERS.

We publish below the earliest information obtainable relating to new electric railways, new electric light companies and projected electric construction of all kinds. Every reader will find these columns of special interest, and manufacturers and supply houses will receive many valuable suggestions looking to new business by carefully watching this department in the ELECTRICAL REVIEW from week to week.

Electric Light and Power.

MANCHESTER, CONN.—The Mather Electric Company has filed with the State Secretary a certificate of reduction of capital from $200,000 to $120,000, and the number of shares from 2,000 to 1,200; also a certificate showing that on October 4 the stock of the company was increased by the issue of preferred stock to the amount of $81,000 in 810 shares of $100 each, to be entitled to a non-cumulative dividend of six per cent.

DULUTH, MINN.—The Electric Motor Company, of Duluth, has been incorporated with a capital of $100,000. The promotors of the company are Daniel H. Merritt, of Marquette, Mich.; Frank A. Merritt, Duluth; George J. Northrop, Marquette, and Arthur R. Roe, Duluth.

SIDNEY, O.—The Sidney Electric Light Company has increased its capital from $15,000 to $25,000.

NORTHFIELD, MINN.—The Northfield Heat, Light and Power Company has filed articles of incorporation with the Secretary of State. Capital, $20,000.

SANDY HILL, N. Y.—The Sandy Hill Electric Light and Power Company, Limited, has filed a certificate with the Secretary of State, announcing that its corporate name has been changed to the Sandy Hill Electric Light and Power Company. J. Edward Howland is president of the company.

FAIRMONT, MINN.—The town of Fairmont recently voted 41 majority for $20,000 bonds for electric lights and water works.

VICTOR, COLO.—The Victor Electric Light, Power and Water Company filed articles of incorporation recently. The company will operate at the towns of Victor, Fremont, Lawrence and Barry, El Paso county. Capital, $100,000. The company will supply electric light and power and water from Wilson creek for irrigation.

NEW YORK, N. Y.—The Curtiss Electrical Company is organized under the laws of New Jersey and has a capital of $100,000. The incorporators are: Henry A. Mandeville, William H. Curtiss, Frank Brew and Frank A. Wright, of South Orange; Stevenson Constable, John R. Weeks and Charles A. Cregin, of New York.

HILLSBORO, ORE.—The Hillsboro Electric Light and Water Company, incorporated. Capital, $40,000.

CRIPPLE CREEK, COLO.—The Cripple Creek Electric Light Company has been granted articles of incorporation, with a capital of $100,000. The directors are Robert P. Davis, Hiram Wilson and Willis S. Montgomery.

MINNEAPOLIS, MINN.—Amendment of articles of incorporation of the Edison Building Company, changing the name to Minneapolis International Electric Company.

New Manufacturing Companies.

EAST LIVERPOOL, O.—The Hulings Electric Company. Capital, $25,000.

MINNEAPOLIS, MINN.—Articles of incorporation of the American Novelty Company, with a capital of $100,000, have been filed. The object of the incorporation is the manufacture of electrical and fortune-telling machines and novelty devices. E. N. Darrow is president of the enterprise, T. E. Penney, vice-president, and A. F. Pray, secretary and treasurer.

New Telegraph Companies.

BROOKLYN, N. Y.—The Citizens' District Messenger Telegraph Company, to carry on operations in Kings and Queens counties. Capital, $25,000. Directors, Henry C. Buckout, Simon E. Ostrom, George D. Short, Dr. George R. Hill, W. W. Grant, George A. Delerce, and Eugene E. Seaman, of Brooklyn.

LITERARY.

"Proceedings of the third convention of the Canadian Electrical Association," held at Toronto, September 12, 13 and 14, 1893, have been received.

The newest Cincinnati telephone directory, that for November, 1893, is a model production. The matter is well arranged and well printed, the index accurate and the directions are brief and to the point.

McGill University, Montreal, Can., has sent to the ELECTRICAL REVIEW a very handsome souvenir pamphlet commemorating the formal opening of the Engineering and Physics Buildings on February 24, 1893.

Scribner's Magazine, for November, opens with a picturesque and amusing travel sketch by Colonel H. E. Colville, C. B., of the Grenadier Guards, in which he describes his experiences while "In Camp with the Katchins"—a tribe of cattle-raiding mountaineers, living near the Chinese frontier of Upper Burma.

"The Annual Club Catalogue and Directory" for 1893 has appeared, and is a great improvement over its predecessor. It contains the names and official statistical information of over 2,500 clubs located in the principal cities of the Union and Canada. The book is typographically excellent, and is handsomely bound in blue and gold. It is published by the Club Publishing Company, 218 William street, New York.

We have received the following: "The International Columbian Naval Rendezvous and Review of 1893, and Naval Maneuvers of 1892" from the office of Naval Intelligence; an announcement and programme of lectures for 1893-1894 from the Franklin Institute; "Journal of the United States Artillery" for October, 1893; "Consular Reports" for October, 1893; "Production of Coal in 1892," by E. W. Parker, from the Department of the Interior; the fifth annual report and transactions for September, 1893, from the Canadian Institute.

The leading feature of the *Review of Reviews* for November is its presentation of the "Possibilities of the Great Northwest," in an article by Mr. S. A. Thompson, and in a supplementary article by Dr. Emory R. Johnson, upon "Inland Waterways for the Northwest." Mr. Thompson, as secretary of the Duluth Chamber of Commerce, has for several years been actively engaged in searching out and applying effective means for bringing the great States northwest of the Upper Mississippi, and the great Canadian provinces belonging geographically to the same region, into closer communication with the rest of the North American continent. He is, therefore, able to write with an enthusiasm born of intimate knowledge of the subject and supported by very important and surprising statistics. Dr. Johnson is lecturer on transportation in the Wharton School of Finance and Economics, University of Pennsylvania, and has recently published a monograph upon "Inland Waterways." Dr. Johnson particularly emphasizes the importance of canal and river transportation as a means of lowering railway rates, and he finds a very large social as well as economic influence resulting from this extension of facilities for shipping and for personal travel. These two articles suggest a future of almost unimaginable growth for the great Northwest. Each article is fittingly illustrated.

The United Press Uses the Long Distance Telephone.

Mr. Fred. N. Bassett, general eastern manager of the United Press, related the following story to a reporter for the New York *Sun*, illustrating the "get there" qualities of the United Press:

"On the day of the third yacht race, when the fate of the cup was decided, there was a great storm in the West, which broke down all the telegraph lines between New York and Chicago. At 7 o'clock in the evening I had before me a very interesting account of how the 'Vigilant' won the third race and the cup, but not the slightest idea of how I was going to let Pittsburgh and Chicago know even which boat had won. I filed copies of the story with the Western Union and the Postal companies and then tried for three hours to make our wires work. It was no use. Chicago was for all practical purposes further away than China.

"At 10½ o'clock I went to the Long Distance Telephone office on Cortlandt street, and asked Mr. E. T. Bonds, the night chief, if he could get a connection with Chicago. He sent for Mr. Hugh Wallace, the day chief, and for two hours they worked together in that office, ringing and helloing like thunderation. At 11 o'clock they got Philadelphia, and shortly after they got Pittsburgh.

"They telephoned to the Pittsburgh operator to attach a Morse instrument to his end of the line and get a man to work it. While he was doing that they attached a Morse instrument to this end of the line. I had several operators with me waiting to pitch in. At midnight it was all in working order, and I telegraphed to the operator in Pittsburgh to telephone to the Chicago operator to attach an instrument to his end of the line. The telephone wire from Pittsburgh to Chicago was all clear, but the Pittsburgh man telegraphed back that there was some hitch in the Chicago office, and that nobody there knew how to attach a Morse instrument to a telephone.

"And then I sent this message:

"'Tell Chicago office to get telegraph operator, and place your transmitter over the ticker so that operator in Chicago can plainly hear the ticking.'

"And that is how it was done. Two operators in Chicago took turns at holding the telephone receiver to their ear with one hand and writing out what the instrument in Pittsburgh said with the other.

"It was 12.30 when we began, and at 2.30 we had sent 3,000 words about the yacht race and the editorial comments of the London papers of that morning upon the result, together with a brief account of the Toulon festivities."

ELECTRIC RAILWAY AND POWER NOTES.

The new management of the Wenstrom Electric Company, in Baltimore, Md., expects to shortly begin operations at the Wenstrom Works, when a large force of men will be put to work. Work left unfinished by the former management will be first completed. Three hundred horse-power can be generated at the works by the water supply at Gwynn's Falls, which will be utilized.

The car stables at West Hoboken, N. J., will be turned into a mammoth electric car shed. The company contemplates erecting a new stable at Ferry street and Central avenue, Jersey City Heights, where the horses will be kept. The substitution of the motors for the horse cars will throw out many hands now employed at the West Hoboken stables, as the company intends to reduce the number of its horses from 500 to 160.

The talk of electric railroad construction in New Hampshire, which has been current for several months, took practical shape last week, when about 70 representatives of New Hampshire towns met in the rooms of the local board of trade, at Haverhill, and discussed plans. Business men from Chester, Raymond, Hampstead, Danville, Sandown, Newton, Atkinson, Plaistow, Derry and Salem, N. H., were present and pledged financial support to any electric railroad scheme that would open up these towns. The plans, as far as developed, are for two lines of electric railroad from Haverhill. One is *via* Atkinson, Hampstead, Chester and Derry to Manchester, N. H., and the other is *via* Ayer's Village, Salem, Windham and Hudson, N. H., to Nashua. Haverhill capital is to be interested, and offers for stock have been made in every town. The first step to be taken is the organization of a corporation preparatory to seeking a franchise from the New Hampshire legislature. The scheme includes over 60 miles of electric road.

TELEPHONE CHAT.

Telephone communication has been opened between Santa Ana and Tustin, Cal.

In the new telephone circuit in Missouri, Moberly is to be the center from which lines will radiate to Macon, Huntsville, Salisbury, Brunswick, Higbee, Renick, Sturgeon and Mexico.

The new telephone company which is being organized about the State of Michigan is said to be obtaining a foothold at Grand Rapids. The backers ask for a franchise and offer to rent 'phones at $24 a year, and also to furnish the city 'phones free of charge.

The White Mountain Telephone Company has completed the line to Sprague's Mills, and now Blaine, Presque Isle and Caribou, Me., are in telephonic connection. This service has been long needed, and the residents of the surrounding districts are elated over the increased facilities thus offered.

The output of the American Bell Telephone Company for the month ending October 20 was as follows:

	1893.	1892.	Inc.	Dec.
Gross output.....	5,129	7,434	.....	2,305
Returned.....	6,811	3,944	2,867	.....
Net, def.,	1,682	3,490	.....	5,172
Since Dec. 20:				
Gross.....	72,291	79,819	.....	7,528
Returned.....	52,520	42,944	9,576	.....
Net.....	19,771	36,875	.....	17,104

The next long distance telephone line to be built by the Sunset Telephone Company, says Division Superintendent Sands, will run from Centralia, Wash., through Oakville, Elma, Satsop, Montesano, Chehalis Boom, Cosmopolis, Aberdeen, South Aberdeen, Hoquiam, Ocosta, Westport, North Cove and Tokes Point to South Bend, with possibly a spur to Willapa. From Westport to North Cove the line will run along the ocean beach. The line will be built the moment business begins to improve.

The Westminster and Burrard Inlet Telephone Company will apply to the Dominion parliament at the next session for permission to extend its line to the boundary, at Blaine, where it is proposed to connect with the Sunset line, which will eventually give telephone communication with Seattle, Tacoma, Portland, Spokane and San Francisco. In anticipation of desired permission, the company have ordered in Germany a cable to cross the Fraser river, and will lay it as soon as it arrives, some time next month. The scheme is in high favor with business men generally.

At Cincinnati, on October 28, the new telephone service was inaugurated, the change from the old to the new exchange being made in two minutes. About two years have been spent in constructing the new exchange, and it is now without doubt one of the very best plants in existence. The switch board, which accommodates about 2,400 subscribers, has the latest self-restoring automatic drops, and is excellently arranged for rapid work. Every facility for perfect service has been provided, including an extensive underground system of cables in tile and cement conduits. Cincinnati is well fixed in telephone matters, and should feel grateful to Captain George N. Stone, general manager of the City and Suburban Telegraph Association, who has done so much to increase the efficiency of the telephone service in Cincinnati and vicinity.

The Interstate Telephone Company, a branch of the Harrison Telephone Company, succeeded last week in securing a franchise from the council of Kansas City, Kan., to construct and operate a telephone system in that city. The franchise is for a term of 20 years. The granting of the franchise is the first move taken in that city toward securing cheaper telephone service after the expiration of the Bell telephone patents in next March. The company proposes to furnish telephones to all responsible parties in the city at a maximum rate of $6 per year for business houses and $4 per year for dwellings. Besides this there is a provision that in consideration of the exemption of license tax and occupation tax the company will furnish the city the free use of eight telephones. The company is making an effort to get a franchise from Kansas City, Mo., also, as without it the Kansas City, Kan., franchise would be of small value.

KINDRED INTERESTS

"A Spin with the G. E. 800" is the title of a beautifully illustrated and artistically constructed booklet issued by the General Electric Company to advertise its electric railway motor of that type.

The Jewell Belting Company, of Hartford, Conn., has issued a pretty pamphlet illustrating and describing the well-known Jewell dynamo belts, belt dressing and belt cement. There are also shown numerous illustrations of electric light and power stations using the Jewell products.

The Universal Electric Company, 36 New street, New York, is sending out in pamphlet form a paper by Albert Stetson, electrical expert, entitled, "Electric Traction in American Cities, with a Statement of the Conduit System Controlled by the Universal Electric Company, of New York."

Fred. A. Scheffler, 74 Cortlandt street, New York, general sales agent for the Stirling Company, has made the following recent sales of the Stirling water tube safety boilers:

Adriance, Platt & Company, Poughkeepsie, N. Y., manufacturers of Buckeye mowers and reapers, 250 horse-power; Simpson & Watkins, Scranton, Pa., three boilers, and a second order for 300 horse-power; Lutz, Lilly & Company, Philadelphia, Pa., second order, 250 horse-power.

In a recent letter Mr. Scheffler says:

We have received numerous letters showing the use of the Stirling boiler as compared with the ordinary type of water tube boiler working side by side, the statements in these letters proving conclusively the fact that the claims for circulation, self-cleaning and economical fuel consumption properties of the boiler are all that the Stirling Company claim.

Thomas Sully, architect, of New Orleans, La., has ordered from the Berlin Iron Bridge Company, of East Berlin, Conn., an iron roof for a sugar house at Tampa, Fla. The building will be 60 feet in width and 125 feet in length, the trusses being entirely of iron, covered with corrugated iron. The new meter house for the East River Gas Company will be entirely of iron and brick. The roof trusses will be of iron covered with corrugated iron and glass, and are designed and built by the Berlin Iron Bridge Company, of East Berlin, Conn. The Philadelphia Traction Company have placed the order for their new power house with the Berlin Iron Bridge Company, of East Berlin, Conn. The side walls will be of brick and the roof will be of iron. The building is 190 feet in width and 168 feet in length, divided into boiler room, engine room and dynamo room.

Queen & Company, Incorporated, Philadelphia, express themselves as exceedingly pleased with the large orders already obtained as a result of their extensive World's Fair exhibits. In addition to commercial instruments they find a steadily increasing demand for the Standard electrical apparatus which they manufacture with the greatest precision, and a number of the principal colleges have purchased extensively from them for laboratory equipment. Among these may be mentioned, Armour Institute, Chicago; University of Chicago, Chicago; Case School of Applied Science, Cleveland; Massachusetts Institute of Technology, Boston; University of Iowa, Iowa City; University of Minnesota, Minneapolis; Alabama A. & M. College, Auburn; Colgate University, Hamilton, N. Y.; Rensselaer Polytechnic Institute, Troy, N. Y.; Adelbert College, Cleveland; University of Wisconsin, Madison; Western University of Pennsylvania, Allegheny; University of Tennessee, Knoxville; University of Nebraska, Lincoln; Northwestern University, Evanston, Ill.; University of Notre Dame, Indiana; University of Illinois, Champaign, etc. Seven separate awards have been granted to Queen & Company in the department of electricity, so that it is evident the high quality of their product was appreciated by the board of judges.

The Commercial Traveler—the Good Samaritan.

On the occasion of a railroad disaster, a salesman of the Joseph Dixon Crucible Company, of Jersey City, N. J., was a passenger on the train. His presence of mind saved from more than slight injury a well-known clergyman. Subsequently the reverend doctor wrote the company complimenting the salesman, and expressed himself as follows regarding the traveling fraternity:

". . . Years ago, in a lecture, I remarked that the good Samaritan was a commercial tourist (drummer). If a man ever wakes up about midnight with the bottom side of his coach in the direction of the stars, he will think that I am right. The drummer of Samaria had the best of oil and wine. The drummer of Jersey City had the best of pencils and the kindest of hearts. The iron horse will dash and the electric light will soon flash through the land where Christ and his apostles once held sweet converse in regard to who was really our neighbor. Methinks I hear the conductor at Jerusalem say, 'All aboard for Jericho. Passengers for Moab take seats in the front car.' The train may be wrecked. If so, I venture to say that the ubiquitous drummer will be the first and the last to administer to the wounded and the dying, while the fat priest and bloated Levite will either be asleep in the Pullman, waiting for the black porter to call them up, or whining about the loss of a silk umbrella or gilt-edged prayer book. The Jersey City drummer will never be known on earth as extensively as the Samaritan, but I am certain that his name will stand as high and his reward be as great in that land where all men will be rewarded according to the deeds of mercy which they perform in this. I know that many of the commercial agents have some habits in error. Yet I want it distinctly understood that the sexton of the church where I am pastor must always invite the commercial traveler to a front seat."

Fastest Time Ever Made.

One of the Royal Blue line trains of the Baltimore and Ohio Railroad, on a recent run between New York and Washington, covered a mile in 39½ seconds as recorded by a mechanical indicator. At this rate the train traveled at the phenomenal speed of a trifle over a mile and a half a minute, or over 90 miles an hour, which surpasses all previous records of fast time. If the speed were maintained the time between New York and Washington would be reduced without stops to two hours and a half, and with stops to three hours. Five hours is now the fastest time between the two cities, and it is made daily by the Royal Blue line only.

Electrical Engineering in Russia.

Herr H. Görz has resigned his position as director of the Allgemeine Electricitats Gesellschaft, of Berlin, to take up the management of the Russian branch of Messrs. Siemens & Halske.

WANTED.—12 Arc Lamps, second hand; good condition; 50 volts each; Brush preferred. Address M. E., *Care Electrical Review,* 13 PARK ROW, N. Y.

WM. A. ANTHONY,
Consulting Electrical Engineer and Electrical Expert.
VINELAND, N. J.

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OFFICE OF SECRETARY.
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COLUMBUS, IND., September 8, 1893.
THE ADAMS ELECTRIC M'F'G CO., ELKHART, IND.
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